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ENVIRONMENTAL ASSESSMENT

ISSUANCE OF AN ENDANGERED SPECIES ACT SECTION 10(a)(1)(A) PERMIT TO THE CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE AND PACIFICORP FOR ACTIVITIES AT THE IRON GATE FISH HATCHERY

JANUARY 23,2013

Title of Environmental Review:	Environmental Assessment Prepared for a National Marine Fisheries Service Action Concerning Issuance of an Endangered Species Act Section 10(a)(1)(A) Permit to the California Department of Fish and Wildlife and PacifiCorp for Activities at the Iron Gate Fish Hatchery
Listed Species Affected:	Southern Oregon/Northern California Coast Coho Evolutionarily Significant Unit
Responsible Agencies and Officials:	National Marine Fisheries Service [----------------]
Contacts:	[----------------]
Location of Proposed Action:	Klamath River and Iron Gate Hatchery, California
Action Considered:	Permit issuance pursuant to Section 10(a)(1)(A) of Endangered Species Act
Legal Mandate:	Endangered Species Act of 1973, as amended, and implementing regulations in 50 CFR Part 222
Environmental Assessment Conducted by:	Department of Commerce National Marine Fisheries Service [----------------]

List of Acronyms

CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FERC	Federal Energy Regulatory Commission
FONSI	Finding Of No Significant Impact
HCP	Habitat Conservation Plan
HSRG	Hatchery Scientific Review Group
HGMP	Hatchery and Genetic Management Plan
HOR	Hatchery Origin
ICP	Interim Conservation Plan
IGH	Iron Gate Hatchery
KHSA	Klamath Hydroelectric Settlement Agreement
mgd	million gallons per day
NMFS	National Marine Fisheries Service
NOR	Natural Origin
NPDES	National Pollutant Discharge Elimination System
pHOS	Percentage of Hatchery Origin Spawners
PNI	Proportionate Natural Influence
pNOB	Proportion of Natural Origin Fish in the Hatchery Broodstock
SONCC	Southern Oregon Northern California Coast
TMDL	Total Maximum Daily Load
TRH	Trinity River Hatchery
UKL	Upper Klamath Lake

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1. INTRODUCTION AND PURPOSE OF AND NEED FOR ACTION

This document describes the environmental effects of the National Marine Fisheries Service's (NMFS) proposed issuance of a permit to the California Department of Fish and Wildlife (CDFW) and PacifiCorp under Endangered Species Act (ESA) Section 10(a)(1)(A) for the coho salmon (*Oncorhynchus kisutch*) artificial production program at Iron Gate Hatchery (IGH). ESA Section 10(a)1(A) authorizes issuance of a permit for scientific purposes or to enhance the propagation or survival of the affected species. IGH is located aside the Klamath River near River Mile (RM) 189.7 just downstream of Iron Gate Dam (RM 190.1) in north-central California. The permit would be issued for a time period of 10 years and would result in application of an exception to prohibition of "take"[1] of Southern Oregon/Northern California Coast (SONCC) Evolutionarily Significant Unit (ESU) of coho salmon. The permit term includes the interim period prior to when main stem Klamath River dams of the Klamath Hydroelectric Project (Federal Energy Regulatory Commission (FERC) Project No. 2082) are anticipated to be removed pursuant to the Klamath Hydroelectric Settlement Agreement (KHSA) if there is an affirmative determination by the Secretary of the Interior as described in the KHSA. This permit would authorize take associated with implementation of the coho salmon hatchery program under a proposed Hatchery and Genetic Management Plan (HGMP) for IGH. As provided under the National Environmental Policy Act (NEPA) and implementing regulations and policy, this Environmental Assessment (EA) analyzes the potential effects of NMFS' Proposed Action of issuance of this permit.

As described in section 4.0 of this EA, there are several potential sources of take associated with the IGH coho salmon program including take associated with the collection of coho salmon spawners at IGH and take of natural coho salmon juveniles by adverse interactions (predation and competition) with IGH production. Monitoring and evaluation activities to enumerate natural origin (NOR) and hatchery origin (HOR) coho spawning escapement in streams associated with the Upper Klamath Population unit, and trapping of juvenile coho in Bogus Creek could also result in take of additional coho salmon.

Two alternatives were identified and considered in this EA. Under Alternative 1 (No Action), if NMFS determines that the application does not comply with the criteria in applicable laws and regulations, NMFS would deny issuance of the ESA Section 10(a)(1)(A) permit to the applicant. Under Alternative 2 (Proposed Action), if NMFS determines that the application does comply with applicable criteria, NMFS would issue an ESA Section 10(a)(1)(A) permit to the applicant[2], permitting implementation of the actions described in the application and associated HGMP.

1.1. Purpose and Need

NMFS is reviewing the ESA Section 10(a)(1)(A) permit application submitted jointly by CDFW and PacifiCorp to evaluate whether the application meets applicable criteria specified in ESA Section 10 and NMFS' implementing regulations, and whether implementation of actions contemplated in the permit application will appreciably reduce the likelihood of survival and recovery of coho listed under ESA. As

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[1] ESA Section 3(19) defines "take" as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."

[2] CDFW operates IGH, and is the primary applicant in the Section 10(a)(1)(A) permit application. PacifiCorp funds operations of IGH consistent with the Company's license obligations and obligations under the Klamath Hydroelectric Settlement Agreement. CDFW will be principally responsible for implementing the terms of the HGMP and any related ESA Section 10 permit.

provided in ESA section 10(a)(1)(A), the purpose for such a permit is for scientific purposes or to enhance the propagation or survival of the affected species, which is the SONCC ESU of coho salmon for this permit application. If NMFS determines that the application meets all of the applicable criteria, NMFS shall issue the ESA Section 10(a)(1)(A) permit to enable implementation of the programs proposed in the permit application and associated HGMP. Issuance of an ESA Section 10(a)(1)(A) permit is a Federal action subject to analysis for potential environmental impacts under NEPA.

1.2. Background

PacifiCorp and CDFW submitted an application for an ESA section 10(a)(1)(A) permit that will authorize CDFW to implement the coho salmon program described in the HGMP at IGH for scientific purposes, and to enhance the propagation and survival of the SONCC coho salmon ESU. The SONCC ESU includes all naturally spawned coho salmon populations in coastal streams between Cape Blanco, Oregon and Punta Gorda, California, as well as three artificial propagation programs, including the Iron Gate Hatchery coho hatchery program. Coho salmon were once numerous and widespread within the Klamath River basin (Snyder 1931), but now only small populations remain and occupy limited habitat within tributary watersheds and the main stem Klamath River below Iron Gate Dam (CDFW 2002, NRC 2004). The Klamath Basin contains nine populations of coho salmon within three distinct diversity strata (Klamath, Trinity, and Central Coastal) (Williams et *al.* 2006). Coho salmon propagated at IGH are part of the Upper Klamath Population unit of the SONCC coho salmon ESU. The Upper Klamath Population unit occupies the mainstem Klamath River and its tributaries between Iron Gate dam (RM 190.1) and Portuguese Creek (RM 128). Other populations in the vicinity of IGH include the Shasta River Population unit (the Shasta River enters the Klamath River at RM 176.6), and the Scott River Population unit (the Scott River enters the river at RM 143). Artificial propagation of coho salmon is necessary because recent adult coho returns to the Upper Klamath Population unit have been decreasing over time to the point where 46 fish returned to the hatchery and only 7 coho to Bogus Creek in 2009. Bogus Creek is located at RM 189.6 and is likely the largest coho producing stream associated with the Upper Klamath Population unit. Based on the declining adult escapement data, it appears that habitat conditions are likely insufficient to maintain this population over time, thus justifying the need for a hatchery program to conserve the remaining genetic resources of the coho population and reduce short-term extinction risks. In addition, recent genetic evidence indicates the need for hatchery reform to reduce inbreeding depression of the hatchery population.

Hatchery operations and management typically involve a variety of different methods and techniques for fish propagation, primarily related to broodstock collection, spawning, mating, fertilization, egg incubation, rearing, tagging, release, in-hatchery and in-river monitoring (e.g., fish health and genetic monitoring), water quality monitoring, adult spawning and weir surveys, and juvenile surveys. Several of the artificial propagation (hatchery) activities proposed in the coho salmon program at IGH could lead to the take of ESA-listed coho and require the issuance of a permit covering activities such as adult broodstock collection, spawning, rearing, tagging, and release of progeny.

Information about the history of salmon propagation in the Klamath River was scarce until the Federal Bureau of Fisheries constructed a fish weir near the Klamathon town site at River Mile (RM) 185.6. From 1910, the weir provided a means to count fish and take eggs for mitigation of a dam built by the Siskiyou Power Company at the current Copco Dam site. In 1911, Sisson Hatchery (Mount Shasta Hatchery) released coho salmon fry into both the Sacramento and Klamath rivers from eggs taken at the weir (Snyder 1931).

In 1912, the Bureau of Fisheries also built a hatchery near Hornbrook and raised Chinook and coho salmon from 1912 to 1916 (HGMP Table 14). The federal government closed the hatchery in 1919. In

1919, the California-Oregon Power Company built a fish hatchery on Fall Creek and rebuilt the Klamathon weir to mitigate for lost habitat above Copco No. 1 dam (Leitriz 1970). The California Fish and Game Commission funded Fall Creek Hatchery as a source of salmon and steelhead eggs until 1961. Approximately 3,400,000 Chinook salmon and 600,000 steelhead were released on average between 1930 and 1948 (KRBTTF 1991).

The IGH facilities were completed in 1966 by Pacific Power and Light (PacifiCorp's predecessor) as mitigation for the loss of spawning habitat in the Klamath River and its tributaries between the Iron Gate Development and the Copco Developments. The Federal Energy Regulatory Commission (FERC) license for PacifiCorp's Klamath Hydroelectric Project (FERC Project No. 2082) stipulates specific production goals from the hatchery for coho, fall Chinook and steelhead. The IGH is owned and funded by PacifiCorp and operated by CDFW. IGH is located on Copco Road, approximately eight miles east of Hornbrook, Siskiyou County, California. The primary spawning facility is located at the base of Iron Gate Dam. This facility includes a fish ladder consisting of 20 ten-foot weir-pools that terminates in a trap, a spawning building and six 30-foot circular holding ponds. The main hatchery is located about ½ mile downstream from the dam and consists of three buildings, office, hatchery and shop, 32 concrete raceways, four employee residences, as well as an eight-step auxiliary fish ladder and trap adjacent to the hatchery rearing ponds.

In 1965, IGH began coho salmon production with 85,020 fingerlings and 65,000 eggs imported from Trinity River Hatchery, which originated at Cascade Hatchery in Oregon (Riley 1967). During its first decade of coho production the hatchery stock used Klamath River coho and coho transferred from Trinity River Hatchery. Since 1976, IGH has used primarily Klamath River coho salmon as broodstock. A variable fraction of the annual return to IGH is of natural origin. Prior to Brood Year (BY) 1994, when hatchery fish were first 100 percent marked, it is likely that the hatchery spawned natural stock in the same proportion as they occurred in the return to the hatchery. Recently, consistent with early implementation of the HGMP (i.e., the Preferred Alternative) in 2011, the goal has been to incorporate between 20-50 percent unmarked adults in the broodstock. Typically, the hatchery has collected about 280 spawners to hedge against in-hatchery losses. The annual size of the IGH coho hatchery broodstock is determined by the mitigation smolt production goal of 75,000.

On May 6, 1997, the final rule was published for listing coho salmon in the SONCC ESU as threatened under the ESA (62 Fed. Reg. 24588). At the time of this listing determination, NMFS excluded hatchery stocks from the listing because artificially produced coho salmon were considered to be non-essential for recovery of the listed species. On June 28, 2005, a final rule was published for listing determinations for 16 salmon ESUs, including the SONCC ESU (70 Fed. Reg. 37160). This SONCC ESU listing included coho salmon produced at IGH, Trinity River Hatchery and Cole Rivers Hatchery (ODFW stock #52) as part of the ESU. The California Fish and Game Commission also listed coho salmon as a threatened species pursuant to the California Endangered Species Act within the California portion of the SONCC ESU on March 30, 2005.

Over the past several years a HGMP has been developed for the IGH coho salmon program to address actions that may result in the take of coho salmon. Recent HGMPs have been developed for individual programs rather than the entire hatchery due to the differences between programs when conducting the HGMP analysis. PacifiCorp and CDFW jointly developed the most recent draft of the coho salmon program HGMP with a conservation focus to protect the remaining genetic resources of the Upper Klamath Population unit.

NMFS uses the information provided in HGMPs to evaluate impacts on ESA-listed salmon and steelhead. HGMPs are used in some cases to evaluate and issue a Section 10 permit application. The IGH coho salmon program HGMP describes the current and proposed coho salmon program, associated performance measures, program impacts, and associated monitoring and evaluation. Development of this HGMP has occurred in conjunction with development of the Interim Operations Habitat Conservation Plan (HCP) for Coho Salmon related to PacifiCorp's Klamath Hydroelectric Project, and the KHSA.

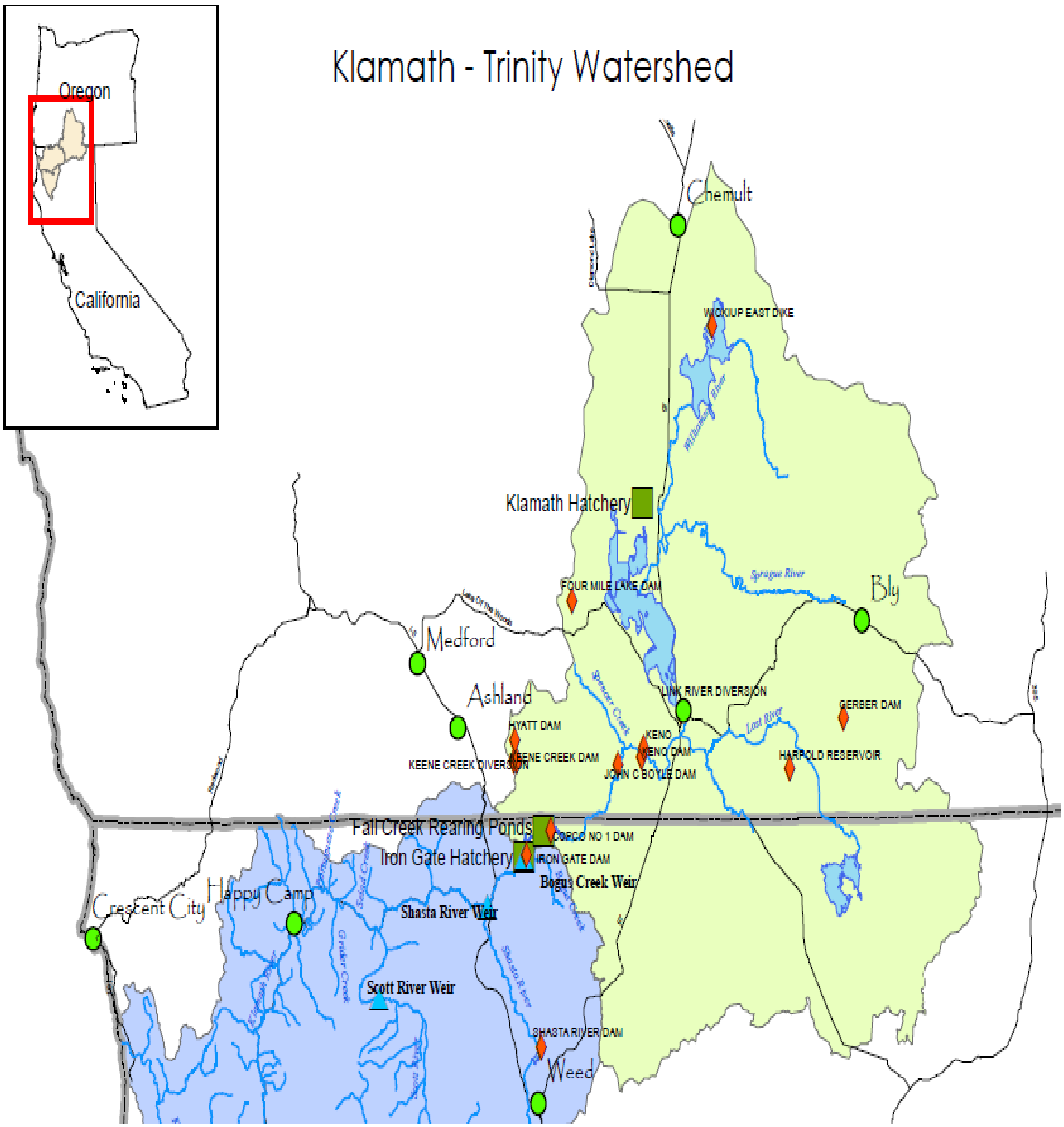

FIGURE 1.
Map of the Klamath River Basin showing the location of Iron Gate Hatchery.

The IGH coho salmon program HGMP is built around the principles and recommendations of the Northwest Hatchery Scientific Review Group (HSRG). The HSRG is the independent scientific review panel for a larger Pacific Northwest Hatchery Reform Project. This project has been aimed at reforming the management and practices of salmon hatcheries across the Northwest. Hatchery reform has been a major issue of concern for state and federal agencies over the past decade and this effort has just recently been completed for California hatcheries, including the IGH coho salmon program and associated HGMP (CHSRG 2012)[3]. Hatchery reform is aimed at conserving the indigenous salmonid genetic resources, maintaining fisheries resources, assisting with the recovery of naturally spawning salmonid populations, and improving the quality and cost-effectiveness of the hatchery program. The HSRGs have reached several critical summary conclusions regarding areas where current hatchery and harvest practices need to be reformed. Each of these conclusions is listed below and was incorporated into the development of the IGH coho salmon HGMP:

- Manage hatchery broodstock to achieve proper genetic integration with, or segregation from, natural populations;
- Promote local adaptation of natural and hatchery populations;
- Minimize adverse ecological interactions between hatchery- and natural-origin fish; and
- Minimize effects of hatchery facilities on the ecosystem.

Specific recommendations from the HSRGs were incorporated into the performance standards for the IGH coho salmon program (HSRG 2004, CHSRG 2012).

1.3. Relationship to Other Agreements, Plans, or Regulatory Requirements

The development of an ESA Section 10(a)(1)(A) permit application and the development and implementation of an HGMP for the IGH coho salmon program is occurring within the larger context of national interest in the Klamath River, its fisheries, and restoration and the interests of tribal fisheries, tribal trust resources, hatchery interests, and listed species recovery. Hatchery operations, hatchery reform, and salmon recovery are also related to several larger, overarching plans, agreements, and regulatory requirements within which the program operates.

In 1956, FERC issued a license to PacifiCorp for operation of the Klamath Hydroelectric Project (FERC Project No. 2082). Article 49 of the Project license required construction of the IGH and Article 50 requires PacifiCorp to fund 80 percent of the ongoing operations and maintenance costs of IGH. In 2004, PacifiCorp filed an application with FERC for a new license to operate the Project. The potential alternatives, environmental impacts and mitigation measures for the continued operation of the Project under a new FERC license were considered in FERC's relicensing process, as documented in the Final Environmental Impact Statement (FEIS) prepared by FERC (FERC 2007). Since the license expired in March 2006, PacifiCorp has been operating the Project under annual licenses under the terms and conditions of the existing license until FERC takes final action on its application for a new Project license.

The hatchery program is also operated consistent with the KHSA (KHSA 2010). Under the KHSA, PacifiCorp commenced funding 100 percent of ongoing hatchery operations and maintenance costs in

[3] The California Hatchery Scientific Review Group recommended that the HGMP for the IGH coho salmon program be approved and implemented.

2010, including funding for a 25 percent constant fractional marking program for fall Chinook. KHSA requirements related to hatchery operations include PacifiCorp funding development and implementation of a Hatchery and Genetics Management Plan for IGH to meet ongoing hatchery mitigation objectives developed by CDFW in consultation with NMFS for a period of eight years following the potential decommissioning of Iron Gate Dam.

In addition, the KHSA provides for the abeyance of the Section 401 Clean Water Act water quality certification process related to PacifiCorp's relicensing application before FERC pending the outcome of the Secretary of the Interior's determination regarding removal of four Project dams, including Iron Gate Dam. If the Secretary of the Interior determines that dam removal should not proceed, or the KHSA terminates for other reasons, the FERC relicensing process for the Project would resume. On September 22, 2011, a notice of availability was published for the Department of the Interior and the California Department of Fish and Wildlife's Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR) (76 Fed. Reg. 58833; September 22, 2011). The EIS/EIR evaluates the effects of removing four dams on the Klamath River in southern Oregon and northern California. The public comment period on the Draft EIS/EIR has ended, but the Final EIS/EIR has not been issued yet.

Furthermore, as provided under the KHSA, PacifiCorp developed the HCP with technical assistance from NMFS and included the HCP with an application for an incidental take permit for coho salmon under Section 10(a)(1)(B) of the ESA for an interim 10-year period until dam removal under the KHSA or relicensing of the Project by FERC. NMFS analyzed the effects of NMFS' Proposed Action of issuance of the incidental take permit related to the HCP in an Environmental Assessment (NMFS 2012a) and issued the incidental take permit. NMFS (2012a) describes the relationship of the analysis of NMFS' proposed issuance of the incidental take permit and associated implementation of the HCP in that Environmental Assessment compared to the Proposed Action of issuing an ESA Section 10(a)(1)(A) permit, which is analyzed in this Environmental Assessment as follows:

> The application for issuance of a permit under ESA Section 10(a)(1)(A) and the associated HGMP will undergo a separate permitting process with a review under the National Environmental Policy Act. Therefore, this EA reviews PacifiCorp's funding of the HGMP and its implementation as part of the HCP conservation strategy in a general sense, but the review under the separate permitting process will specifically review actions to be undertaken under the proposed ESA Section 10(a)(1)(A) permit.

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

Two alternatives were identified and considered in this EA: Alternative 1 (No Action) and Alternative 2 (Issuance of the ESA Section 10(a)(1)(A) permit and implementation of the HGMP).

2.1. Alternative 1 (No Action): NMFS Denial of 10(a)(1)(A) Permit – Coho Program without HGMP

Alternative 1 (No Action) would apply if NMFS concludes that the permit application does not meet ESA Section 10(a)(1)(A) permit issuance criteria. Under this alternative, NMFS would not issue an ESA Section 10(a)(1)(A) permit to CDFW and PacifiCorp for implementation of the coho salmon program at IGH.

If NMFS denies this permit application, then the hatchery coho salmon program and associated monitoring and evaluation actions would need to be conducted at IGH to avoid violating take prohibitions in 50 CFR § 223.203, which is a regulation that NMFS promulgated under ESA Section 4(d) to protect threatened anadromous fish, including coho salmon. CDFW and PacifiCorp would have to decide how to proceed in implementing the coho salmon program at IGH. Therefore, it is unclear at this point how all of the elements of the program would be implemented.

Under the No Action alternative, the conservation measures proposed in the HGMP to improve the coho salmon program may not be fully implemented because take of listed coho salmon would be unauthorized, including collection of listed adult coho salmon used as broodstock, and handling of juvenile coho salmon. The HGMP contemplates the collection and handling of listed adult coho salmon. Consequently, without take authorization, collection and handling of listed coho salmon may cease, and other sources of hatchery broodstock would need to be identified. The use of hatchery broodstock other than Klamath Basin natural origin coho would be inconsistent with the HGMP.

2.2. Alternative 2 (Proposed Action): NMFS Issuance of 10(a)(1)(A) Permit – Coho Salmon Program with HGMP

The Proposed Action is NMFS' proposed issuance of a permit under ESA Section 10(a)(1)(A) for a period of 10 years if NMFS determines that the application submitted by the CDFW and PacifiCorp for operation of the coho salmon program at IGH meets the ESA section 10(a)(1)(A) permit issuance criteria. As a result of permit issuance, an exception to the take prohibitions in 50 CFR § 223.203 would apply to the authorized activities. These authorized activities are outlined in the HGMP and permit application and include actions related to propagation of coho salmon at IGH (as described below in section 2.2.1) and monitoring of coho salmon in the Klamath River (as described below in section 2.2.2). Through implementation of this HGMP, the IGH coho salmon program will be operated to conserve listed species.

2.2.1. Artificial Propagation

The HGMP includes a number of types of activities, all directed toward improving the propagation of coho salmon at IGH.

(1) Collection for Broodstock – Under existing hatchery operations, a maximum of 270 coho may be needed for broodstock. As the HGMP is implemented, it is expected that survival rates in the hatchery

will improve and that the target of 135 coho for broodstock will be met. Of the fish needed for broodstock, up to 50 percent of these could be of natural origin (NOR). Additionally, some NOR adults not needed for broodstock may enter the facility. The collection, tagging and release of NOR fish back to the river may result in injury or mortality. It is expected that less than 1 percent of the fish collected and released will suffer injury sufficient to result in mortality (Keith Pomeroy, Hatchery Manager II, pers. comm. 2012). The handling and lethal take of natural origin (NOR) and hatchery origin (HOR)adult coho for broodstock may occur at three locations: the Bogus Creek weir; the auxiliary fish ladder at IGH; and the main fish ladder below Iron Gate Dam. Broodstock will be collected at random throughout the entire run at all locations in accordance with procedures for fish collection and transportation described in HGMP Section 7. Those NOR and HOR adults not needed for broodstock will be released back to the river. Any deviations to the above referenced broodstock collection targets must be approved by NMFS and CDFW annually.

(2) Measures to Address Genetic Concerns – In addition, the HGMP proposes certain hatchery management measures to minimize domestication and divergence, as well as mitigate adverse genetic or ecological effects to listed natural fish because of broodstock selection practices:

- All juvenile fish releases will be marked for identification upon return. This allows managers to determine and control the proportion of hatchery fish spawning naturally (reducing adverse genetic impacts) and implement selective fisheries for HOR adult if needed.
- Only local broodstock will be spawned - either hatchery fish originating from IGH or unmarked fish volitionally entering IGH or captured at the Bogus Creek weir. Fish locally adapted to the receiving environment are assumed to have higher survival rates and fitness.
- Trinity River Hatchery fish will not be used as broodstock. The use of non-locally adapted fish as broodstock reduces population fitness and survival.
- When available, a minimum of 20 percent and maximum of 50 percent of the broodstock will consist of natural origin (unmarked) fish. Incorporation of natural origin fish as broodstock ensures that the hatchery population does not diverge genetically from the natural population.
- Broodstock (ripe or near ripe) will be collected throughout the run with no bias toward physical characteristics (e.g. size). Collecting fish throughout the entire migration maximizes retention of natural run characteristics and helps ensure that hatchery practices are not selecting for specific traits that may reduce fitness.
- Genetic analysis will be performed on broodstock to develop a spawning matrix that will minimize inbreeding and improve fitness;
- Jacks will be incorporated into broodstock at rates as determined by the spawning matrix provided for in the HGMP. Jacks allow for gene flow between brood years and eliminate genetic divergence between years.
- The abundance and hatchery-wild composition of natural spawning escapement in Bogus Creek will be monitored and managed. The goal is to have the natural rather than the hatchery environment drive local adaptation, since fish adapted to the natural environment are likely to have higher survival rates and be more resilient to environmental change.
- Spawning escapement abundance and hatchery-wild composition in other Upper Klamath tributaries will be monitored. Hatchery fish strays spawning in the wild have the potential to reduce the fitness, diversity, and productivity and survival rates of natural populations. Pedigree analyses will be conducted to determine the productivity of natural origin (NOR) and hatchery origin (HOR) adults spawning naturally. These analyses will allow assessment of whether HOR fish spawning with NOR fish may be reducing the productivity of the natural population.

- Coho salmon will be volitionally released as yearling smolts so that only migratory fish leave the hatchery system. Fish that are ready to smolt are more likely to migrate rapidly to the estuary upon release, again reducing competition and predation effects on NOR coho salmon.
- To reduce impacts of hatchery releases to naturally produced coho, fish will be released at a size (15 fish per pound) that mimics the size of a wild coho juvenile. This action is anticipated to reduce HOR fish competition and predation on both NOR coho and fall Chinook salmon juveniles.

(3) Hatchery Management to Overcome Past Obstacles to Hatchery Breeding – The HGMP also proposes certain measures to address past impediments to artificial propagation. The number of eggs taken has averaged approximately 389,000 since 1993. Green egg-to-ponding survival rates from 1998 to 2009 have averaged 46 percent. The low survival rate is a result of low fertilization rates and low egg to smolt survival rates. Low egg incubation survival rates may also be influenced by detritus load in the hatchery water supply. The HGMP proposes to use multiple males per female and to improve egg incubation and rearing survival through changes to culture and rearing methods, including the installation of a moist air incubation system to address potential hatchery water supply water quality effects on egg survival. With improved hatchery culture practices surplus egg numbers are expected to be minimal. The hatchery goal is to not exceed egg-take by more than 10 percent of that needed to achieve the juvenile release target. Because coho are listed, all eggs will be reared to yearling smolts and released. No eggs will be purposely destroyed without the approval of NMFS. Ponding to yearling survival rates are low primarily due to bird predation. IGH employed temporary netting over the raceways from 1995-2000, but it was removed in 2001 because of worker safety concerns. A new safer netting system was installed at the hatchery to reduce bird predation on ESA-listed coho in 2010. The program has a goal of achieving a ponding to yearling smolt survival rate of 90 percent.

2.2.2. Monitoring and Evaluation

Included in implementation of the HGMP are monitoring efforts associated with the coho salmon program. These include coho spawner/carcass surveys, pedigree analysis, and smolt trapping and assessment. The HGMP Monitoring and Evaluation (M&E) program will also include conservation measures, genetic analysis, and rearing and release techniques that maximize fitness and reduce straying of hatchery fish to natural spawning areas. In accordance with applicable regulations, monitoring and evaluation activities in this HGMP are focused on ensuring that the performance standards and indicators identified for the program are achieved, and that critical uncertainties are addressed.

The focuses of the M&E program are:

- Ensuring that performance indicators and standards are achieved and that hatchery operations produce healthy, disease-free fish that survive to adulthood at high rates; and
- Addressing the critical uncertainties and assumptions that affect the combined performance and genetic makeup of the NOR and HOR components of the Upper Klamath Population unit of coho salmon (as described above in section 1.2).

Ultimately, the M&E program will be used to adaptively manage both the hatchery and natural components of the Upper Klamath Population unit. For example, as natural production increases, the number and proportion of HOR adults allowed on the spawning grounds will decrease. Additionally, actions such as the use of bird netting and water filtration to improve in-hatchery coho survival rates will be monitored and additional actions taken if survival goals are not achieved.

The components of the M&E Plan are:

Coho Surveys – Coho spawning and carcass surveys will be conducted yearly in the main stem Klamath River and tributaries associated with the Upper Klamath Population unit. The surveys will be conducted weekly starting in mid-September and continuing through January 15. Fish carcasses will be sampled for marks, sex and size (length). All females (or a subset if numbers are too high) will be sampled for spawning success (i.e. egg retention). Tissue samples will be collected from a subsample of the carcasses (HOR and NOR) for genetic analyses (see description below of pedigree analysis measure)[4]. These surveys may result in take of some coho salmon. It is estimated that up to 50 NOR live adults may be impacted by this work. Methods proposed in the surveys are designed to reduce this impact to the extent possible while still collecting needed data. Coho redds will be enumerated and uniquely marked (tape, GPS etc.) during each survey. The combined carcass and redd counts will be used to estimate adult NOR and HOR escapement levels and spawn-timing to each stream and for the Upper Klamath Population unit as a whole. As part of its annual monitoring program, CDFW will continue to operate video counting stations in Bogus Creek, Shasta and Scott Rivers to determine coho escapement levels and composition (HOR and NOR). These data will be summarized and reported in annual reports for each basin.

Pedigree Analysis - A pedigree analysis using tissue samples taken from both hatchery and naturally produced coho adults from the survey streams will be used to determine the reproductive success of both the natural and hatchery components of the coho run. DNA results for the hatchery and natural components of the population will be compared to determine: 1) if they are genetically distinguishable, and 2) the reproductive success of each component.

Juvenile Migration - A downstream migrant trapping facility (screw trap, fyke net, etc.) will be operated in Bogus Creek (or just downstream) to collect demographic data on natural origin juvenile run-timing and abundance, size, smoltification levels and smolt-to-adult survival rates. This information will act as the standard hatchery fish are compared against to determine if hatchery practices are producing a high quality smolt capable of surviving in the natural environment.

Bogus Creek Weir Operations - The weir structure will be improved to operate at higher flows, better manage debris[5], and allow for the collection of adult and jack coho for hatchery broodstock if needed. Other purposes of the weir are the enumeration of coho spawning escapement.

The operation of the Bogus Creek weir to enumerate coho spawning escapement and collect broodstock for the program may result in the take of coho salmon. The level of take from capture during broodstock activities at Bogus Creek weir will vary with run size and range from 0 to 135 fish, with up to 50% being NOR. Intentional lethal take of fish for broodstock will range from 0-135 fish. Unintentional lethal take from transportation may result in up to 1% mortality of all fish that are transported from the Bogus Creek weir to the hatchery. Lethal take associated with juvenile downstream migration monitoring activities will be between 0 – 100 fish, depending on escapement levels. Potential take levels will be monitored directly by CDFW staff on a daily basis. If take is likely to exceed authorized levels, CDFW will consult with NMFS to determine appropriate actions. Take levels will not be exceeded without the permission of NMFS. See table 10 in the HGMP for more information on potential take levels.

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[4] Sample size will be determined as more is learned about the number of adults returning to each stream.

[5] Debris caught on weir pickets is removed as needed to limit impacts such as descaling that may occur as juvenile fish pass through weir spacings.

The HGMP also includes in-hatchery and in-river monitoring to assess program effectiveness based on a series of performance metrics as described in HGMP Section 11.0. In-hatchery monitoring will collect data to determine and quantify in-hatchery performance for IGH with regard to the following metrics:

- Broodstock composition, timing, age structure
- Adult Holding and Spawning Survival Rate
- Proportion natural origin brood (pNOB) for each brood year
- Egg-to-Fry Survival Rate
- Fry-to-Parr Survival Rate
- Egg-to-Smolt Survival Rate
- Smoltification Level (based on ATPase data)
- Release Size (size of HOR fish at release)
- Smolt-to-Adult Survival Rate (SAR)
- Total Smolt-to-Adult Survival Rate (TSAR)

2.2.3. Duration

The term of the permit and time frame for implementation of the HGMP would be 10 years, from 2013-2023. Under the KHSA, PacifiCorp is obligated to fund continued hatchery operations for a period of 8 years after potential removal of Iron Gate Dam. Revised hatchery management goals and strategies will be developed by CDFW and NMFS in response to reintroduction of coho to habitat above Iron Gate Dam (KHSA 2010). At that time it is expected that a new HGMP would be developed for any new or revised programs at Iron Gate or other hatchery facilities in the area. NMFS cannot determine at this time what any new or revised coho salmon program would include. Therefore, NMFS cannot determine the effects of any such new or revised program. Any take associated with any new or revised coho salmon program would need to be authorized under a new ESA Section 10 permit.

2.3. Alternatives Considered but not Analyzed in Detail

In its analysis of the Iron Gate coho salmon program, NMFS, working with CDFW and PacifiCorp, conducted an alternatives analysis to determine the best approach for meeting identified conservation, harvest and policy goals (see Appendix A of HGMP). The four alternatives examined were:

1. Maintain current hatchery program without issuance of a Section 10(a)(1)(A) permit
2. Eliminate hatchery production and improve habitat
3. Implement a segregated program consistent with Hatchery Scientific Review Group (HSRG) Guidelines
4. Implement an integrated program consistent with HSRG Guidelines

The Preferred Alternative was developed based on the results of the alternatives analysis presented in the HGMP (Appendix A) for the existing coho program. The key findings of this analysis were as follows:

1. Based on the data available, natural origin abundance of the Upper Klamath Population unit is

below the high risk abundance level (241) established by NMFS[6].

2. Adult coho natural production needs to be increased to reduce demographic and life history diversity risks to the population unit.

3. Hatchery operations need to strike a balance between genetic and demographic risk to the combined (hatchery origin and natural origin) coho population.

4. Habitat quality and quantity need substantial improvement to maintain natural coho production in the basin.

NMFS concluded that none of the four alternatives examined would result in outcomes consistent with these findings. Thus, NMFS will not analyze these alternatives in detail in this Environmental Assessment. In addition, except as described for purposes of analysis and comparison under the Effects from Alternative 1 (No Action) in section 4.1 below, NMFS rejected from detailed analysis maintaining operations at the hatchery, including collection of listed coho salmon, without issuance of a Section 10(a)(1)(A) permit because such an alternative may not allow for the collection of listed coho salmon. NMFS, working with CDFW and PacifiCorp, developed the preferred alternative as a combination of alternatives two and four above that would most likely result in outcomes consistent with the findings described above and would most likely result in increase of the abundance, productivity and life-history diversity of the Upper Klamath Population unit.

Based on these findings, the Iron Gate Hatchery coho program was modified with a conservation focus, wherein hatchery production (following HSRG guidelines) is used to protect the genetic resources of the Upper Klamath River coho population (Alternative 4) until habitat conditions improve (Alternative 2). Habitat improvement and research actions have been implemented as part of PacifiCorp's Interim Conservation Plan (ICP) and are currently being implemented as part of PacifiCorp’s HCP. Other habitat improvement and research actions are also ongoing under the direction of CDFW, the U.S. Fish and Wildlife Service (USFWS), NMFS, and Klamath basin Tribes. Hatchery management under the HGMP and conservation actions under the HCP and other ongoing initiatives will be coordinated to maximize the conservation benefits.

3.AFFECTED ENVIRONMENT

The affected environment in this analysis is defined as that portion of the physical, biological, and social environment that may be affected by implementation of the alternatives. The Proposed Action would impact resources in the Klamath Basin and could impact resources in the marine environment because released coho salmon migrate to the ocean. Resources that could be impacted and are part of this

[6] The alternative analysis used a value of 425 for the high risk criterion. This number was adjusted to 241 by NMFS in their review of the draft HGMP to account for inaccessible habitat above Iron Gate Dam.

environmental analysis include water resources (i.e., hydrology and water quality), biological resources (including fish species and fish-eating birds), socioeconomics and environmental justice. The Proposed Action is not expected to have effects on other resources (i.e., geologic resources, land use, air quality, noise, visual resources, recreational resources, vegetation, and species of wildlife other than those addressed), so these other resources are not specifically addressed in this analysis.

3.1. Water Resources

Originating from Upper Klamath Lake (UKL) in southern Oregon, the Klamath River flows 254 miles from Oregon into northern California before emptying into the Pacific Ocean near Klamath, California. The river drains an area of about 13,000 square miles. The Klamath River watershed is only one of three drainages originating in Oregon that cut across both the Cascade and Coastal ranges. The Klamath River basin lies in the transition zone between the Modoc Plateau and Cascade Range physiographic provinces, with the Klamath River cutting west through the Klamath Mountain province and then the Cascade range province where it reaches the Pacific Ocean. The Klamath River passes through four distinct geologic provinces, each of which changes the character of the river's channel morphology and that of its tributary watersheds, varying the supply of inputs such as water, sediment, nutrients, and wood.

Built between 1903 and 1962, PacifiCorp's Klamath Hydroelectric Project consists of seven hydroelectric developments and one non-generating dam; all but one of these facilities is located on the Klamath River. UKL is formed by the Link River Dam which is owned by the U.S. Department of the Interior, Bureau of Reclamation. Water stored and released from Link River Dam is used to meet fish and wildlife habitat needs, for irrigation purposes, flood control requirements, and hydroelectric generation.

3.1.1. Hydrology

Flows in the Klamath River normally peak during the late spring and/or early summer from snowmelt runoff. Low flows in the Klamath River typically occur during the late summer or early fall, after the snowmelt and before the runoff from the fall storms moving inward from the Pacific Ocean. The hydrology in the Klamath River affects various aspects of important life history stages of aquatic species such as anadromous salmon. For example, natural flows in the late summer and early fall trigger adult run timing and migratory routes for certain salmonids, and natural flows in the spring trigger juvenile outmigration to the sea. Alterations in natural flow regimes can negatively affect these critical life history traits, as well as influence water temperatures in the river (as described below in section 3.1.2), which are important in the growth and survival of basin salmonids. The dams on the Klamath River affect how long it takes for water to travel from Upper Klamath Lake to the estuary (except for Copco No. 2 dam, which has a small reservoir and does not appreciably affect water travel time). The dams increase the time it takes water to travel through the upper 60 miles of the river between Link River and Iron Gate dams. The transit time of waters released from Upper Klamath Lake to the estuary (as well as water released from Reclamation's Klamath Project to the river between Upper Klamath Lake and Keno dam) is about 1 to 2 months or more, except during high winter flow conditions when the transit time may be reduced to as little as 2 weeks. If no dams were in place, transit time from Upper Klamath Lake (Link River dam) to the estuary would be about a week during summer periods and less during winter high flow events.

3.1.2. Water Quality

The Klamath River system is complex and unique, particularly because water quality generally improves as water flows from its source at UKL towards the estuary. In most river systems, water quality is highest at its source and degrades as water flows downstream. Because the Klamath River defies this norm, the Klamath River is often referred to as "upside-down."

The area affected by both alternatives in terms of water quality is the Upper Klamath reach below Iron Gate Dam, which is the Project dam that is furthest downstream on the Klamath River, and it does not have facilities for passage of anadromous fish. The hatchery plays a minimal role in affecting Klamath River water quality conditions, which are naturally productive. The Klamath River downstream of Iron Gate Dam can be described as a eutrophic stream. Winter conditions are generally benign from a water quality perspective with cool to moderate water temperatures and dissolved oxygen conditions at or near saturation. Although there may be nutrients sufficient for primary production, low water temperatures and short day length preclude a large algal standing crop. Conditions change markedly with the onset of warmer weather. Water temperatures rise and primary production (benthic algae) can lead to deviations in dissolved oxygen (above and below saturation), but these effects are spatially variable. Primary production is driven in large part by nutrients from upstream sources, with tributaries generally providing waters that are lower in nutrients and organic matter. The information provided below has been summarized from NMFS (2012a), NMFS (2010), NCRWQCB (2010), and Basdekas and Deas (2007) and more information on water quality conditions can be found in these sources.

3.1.2.1. Temperature

Water temperatures in this reach are generally at or near equilibrium with ambient air temperature, with the exception of immediately below Iron Gate Dam and in the vicinity of certain tributaries. Summary statistics compiled by the U.S. Environmental Protection Agency (USEPA) indicate that in June, water temperatures at locations between Iron Gate dam and above the confluence with the Scott River range from about 16 to 22°C, while in July, temperatures range from 16 to 26°C. In August the minimum temperatures are higher but the maximum temperatures are lower than in July.

Water temperatures below Iron Gate Dam may be at or slightly below equilibrium temperature of the river downstream of the dam in the spring (the river is considerably smaller in terms of volume per unit length, and thus cools and heats more quickly than the reservoir in response to the ambient meteorological conditions). During the fall period, water temperatures of releases from Iron Gate dam are higher than equilibrium temperature of the river due to the thermal lag caused by the Project reservoirs and water storage. This lag is largest at Iron Gate Dam and diminishes relatively quickly in the downstream direction as the river comes into equilibrium with the local meteorological conditions. By the time flows reach the Shasta River, the impact of the lag is diminished by approximately 50 percent, and continues to diminish in the downstream direction.

3.1.2.2. Dissolved Oxygen (DO)

DO concentrations vary considerably both spatially and temporally within the Klamath River mainstem, and are influenced primarily by high nutrient levels emanating from the upper basin (PacifiCorp 2006). Daily mean dissolved oxygen conditions are at or near saturation throughout much of the reach due to the many cascades, rapids, and riffles in this steep reach of river that provide mechanical reaeration. An exception is the reach immediately below Iron Gate Dam during late summer and fall periods, where relatively deep releases from Iron Gate reservoir entrain water with low dissolved oxygen concentration, resulting in discharges from the dam of water that is below 100 percent saturation. The Klamath River at several locations further downstream experiences “chronic” mild subsaturation during the warmer periods of the year (PacifiCorp 2008). These are conditions when the average dissolved oxygen concentration over a period of time (days or weeks) is below saturation, and dissolved oxygen never rises above saturation. It is postulated that this mild, persistent subsaturation is related to the appreciable organic load being carried by the river. During winter, DO conditions are typically at or near saturation throughout the reach.

3.1.2.3. pH

Given that the Klamath River below Iron Gate Dam remains in a weakly buffered state, pH levels throughout the river can experience wide daily fluctuations as a result of high primary production (i.e., algae and benthic macrophyte growth) during summer months. Photosynthesis and associated uptake of carbon dioxide by aquatic plants result in high pH (i.e., basic) conditions during the day, whereas plant and fish respiration at night decreases pH to more neutral conditions. Alkalinity is generally under 100 mg/L throughout the reach but it is not uncommon to observe pH values in excess of 9.0 in the early afternoon during late spring and summer periods in the Klamath River. Ammonia toxicity can be a concern in aquatic environments, like the Klamath River, where high nutrient concentrations coincide with elevated pH and water temperature. Ammonia toxicity may be a concern in the river from Iron Gate Dam to Seiad Valley (RM 128) where temperatures and pH, as well as macrophyte and algae concentrations, are appreciably higher than those common to the lower river (PacifiCorp 2006).

3.1.2.4. Nutrients and Algae

During summer and fall periods there is a considerable amount of particulate matter readily observable in the Klamath River in this reach. The proportion of this particulate matter that is derived from Iron Gate reservoir and upstream sources compared to that generated within the river downstream of Iron Gate Dam is unknown at this time but decreases with distance downstream. The eutrophic nature of the Klamath River downstream of Iron Gate Dam is largely due to upstream sources of nutrients. This particulate matter (and presumably dissolved matter as well) is readily transported downstream and a portion ultimately settles in the Klamath River Estuary.

3.2. Biological Resources

The biological resources potentially affected by the Proposed Action are those within the Klamath River Basin below Iron Gate Dam. The status of listed and unlisted salmonid species is discussed below, as well as the status of other fish species in the Basin.

3.2.1. Fish Species

3.2.1.1. Fish Species Listed under the ESA

3.2.1.1.1. Southern Oregon/Northern California Coast Coho Salmon ESU

A full description of the status of the SONCC coho salmon ESU and the population units in the vicinity of IGH can be found in the draft HGMP and in recent reports, biological opinions, and status reviews (NMFS 2012a, NMFS 2010, Ackerman et *al*. 2006, Good et *al*. 2005). It is a requirement of the HGMP process and permit application to provide this information. A brief summary of the status of the species is provided here.

Coho salmon were once numerous and widespread within the Klamath River basin (Snyder 1931), but now only small populations remain and occupy limited habitat within tributary watersheds and the main stem Klamath River below Iron Gate Dam (CDFW 2002, NRC 2004). As described above in section 1.2, the Klamath Basin contains nine populations of coho salmon within three distinct diversity strata (Klamath, Trinity, and Central Coastal) (Williams et *al.* 2006). Populations in the vicinity of IGH include the Upper Klamath Population unit, which occupies the main stem and tributaries downstream of Iron Gate Dam and upstream of the confluence of Portuguese Creek; the Shasta River Population unit; and the Scott River Population unit.

Coho salmon adults migrate and spawn in small streams that flow directly into the ocean, or tributaries and headwater creeks of larger rivers (Moyle 2002, Sandercock, 1991). Adults migrate upstream to spawning grounds from September through late December, peaking in October and November (National Research Council 2004). Spawning occurs mainly in November and December, with fry emerging from the gravel in the spring, approximately 3 to 4 months after spawning. Hicks (2000) states that spawning activity in coho salmon typically occurs in the temperature range of 4.4 to 13.3°C. Bell (1991) suggested that daily average temperatures should be within the range of 10 to 13°C for successful spawning of coho salmon. Under current conditions, daily average water temperatures in the Klamath River during the November to January spawning period are typically less than 13°C (PacifiCorp 2008).

Coho salmon eggs typically hatch within 8 to 12 weeks following fertilization, although colder water temperatures may lengthen the process (Bjornn and Reiser 1991). Suitable water temperatures for egg incubation are similar to those for spawning (McCullough et *al.* 2001). Under current conditions, daily average water temperatures in the Klamath River during the November to March incubation period are typically less than 14°C (PacifiCorp 2008).

At a length of 38 to 45 mm, fry may migrate upstream a considerable distance to reach lakes or other rearing areas (Sandercock 1991, Nickelson et *al.*, 1992). Juvenile rearing usually occurs in tributary streams with a gradient of 3 percent or less, although they may move up to streams of 4 percent or 5 percent gradient. Juveniles have been found in streams as small as one to two meters wide. They may spend 1 to 2 years rearing in freshwater (Bell and Duffy 2007), or emigrate to an estuary shortly after emerging from spawning gravels (Tschaplinski 1988).

Suitable spawning and rearing habitat exists throughout the Klamath River basin, such as the Scott and Shasta Rivers, as well as smaller main stem tributaries throughout the basin, which were once highly productive coho salmon watersheds, but anthropogenic factors have severely degraded instream habitat conditions. Coho salmon juveniles are also known to redistribute into non-natal rearing streams, lakes, or ponds, often following rainstorms, where they continue to rear (Peterson 1982). Typical rearing habitat consists of slow moving, complex pool habitat commonly found within small, heavily forested tributary streams. Large woody debris and other instream cover are critically important to juvenile coho salmon survival, considering the relatively smaller coho salmon are often at a disadvantage during aggressive interactions with other juvenile salmonids (e.g., Chinook salmon and steelhead). Despite documented coho salmon preference for tributary rearing habitat, juvenile coho salmon have also been observed residing within the main stem Klamath River downstream of Iron Gate Dam within the upper reaches of the Klamath River throughout the summer and early fall (Soto 2007 in NMFS 2007a). These fish are almost always closely associated with cold water refugial habitat and extensive instream cover near tributary confluences, where water temperatures are 2-6°C lower than the surrounding river environment (NRC 2004 Sutton et *al*. 2004).

Emigration from streams to the estuary and ocean generally takes place from February through June, with the peak period being the end of April through May (USFWS 1998). Generally, the fish live in the ocean until they return to freshwater to spawn at the age of 3 years (NRC 2004) but some sexually mature males (jacks) return after one summer in the ocean.

Recent population data indicate that coho abundance in the Klamath River is quite low. It is estimated that minimum natural run size was only 664 fish in 2009. This number of fish is approximately 30 percent of the High Risk annual abundance level established by NMFS (2010). A High Risk population is one where a species faces significant risks from internal and external processes that can drive a species to extinction (NMFS 2010). Coho returns to the Upper Klamath Population unit (based on returns to Bogus Creek and the hatchery) were less than 50 adults in 2009. A total of 46 coho adults returned to IGH in 2009 (of which 11 were from the Trinity River hatchery). Adult return data for 2009 indicate that multiple Klamath River population units are at high risk of extinction. The risk occurs because of low population abundance, spatial diversity (lack of strong population units) and low productivity.

3.2.1.1.2. Southern Distinct Population Segment of Pacific Eulachon

The eulachon (*Thaleichthys pacificus*) or candlefish is a smelt that reaches the southern extent of its range in the Mad River, Redwood Creek, and the Klamath River (Moyle 2002). The Southern Distinct Population Segment (DPS) of Pacific eulachon (hereafter referred to as eulachon) was recently listed as a threatened species (75 Fed. Reg. 13012; March 18, 2010). This DPS encompasses all populations within the states of Washington, Oregon, and California and extends from the Skeena River in British Columbia (inclusive) south to the Mad River in Northern California (inclusive).

Eulachon are a short lived, high fecundity, high mortality forage fish, and tend to have extremely large population sizes. Eulachon generally spawn in rivers that are either glacier or snowpack fed and that experience spring freshets. Spawning grounds are typically in the lower reaches of larger rivers fed by snowmelt and spawning typically occurs at night. Spawning occurs at between 0 to 10°C throughout the range of the species, and is largely limited to the part of the river that is tidally influenced (Lewis et *al.* 2002). Entry into spawning rivers appears to be related to water temperature and the occurrence of high tides (Ricker et *al.* 1954, Smith and Saalfeld 1955, Spangler 2002), and occurs in January, February, and March in the northern part of the DPS, and later in the spring in the southern parts of the DPS. It has been argued that because these freshets rapidly move eulachon eggs and larvae to estuaries, it is likely that eulachon imprint and home to an estuary into which several rivers drain rather than to individual spawning rivers (Hay and McCarter 2000). Eulachon eggs average 1 mm in size and are broadcast into the water column, attaching to a variety of substrates from sand to pea-sized gravel. Newly hatched young, transparent and 4-7 mm in length, are carried to the sea with the current (Hay and McCarter 2000). They rear in the pelagic zone and return to freshwater to spawn after 3 to 5 years at sea.

Historically, large numbers of eulachon entered the Klamath River to spawn in March and April, but they rarely moved more than 8 miles inland (NRC 2004). Spawning occurs in gravel riffles, and the embryos take about a month to develop before hatching. Upon hatching, the larvae are washed into the estuary. The eulachon in the Klamath River once was an important food of the Native Americans in the region (Trihey & Associates 1996). Moyle (2002) states that eulachon have been scarce in the Klamath River since the 1970s, with the exception of 3 years: they were plentiful in 1988 and moderately abundant again in 1989 and 1999. Based on interviews with Yurok tribal elders, Larson and Belchik (1998) state that most tribal fishers perceived a decline in the mid to late 1970s, although a smaller number thought that it was in the 1980s. Similar declines have been noted elsewhere within the species range. The Klamath River is believed to support the largest population of eulachon in California. The species is known to spawn at least as far as 8 miles upstream in the Klamath River (Fry 1979, Hamilton et *al*. 2005), and Larson and Belchik (1998) noted that adults generally migrate up to Pecwan Creek or near Weitchpec. Specific spawning areas are not well known. In March 2010, NMFS listed the Southern DPS, which includes the Klamath River population, of eulachon as threatened (75 FR 13012; March 18, 2010). Primary factors cited as threatening the species include climate change, commercial fisheries, and altered freshwater habitat. NMFS is unsure as to the viability of eulachon in the Klamath River given uncertainty that the abundance is sufficient to support a self-sustaining population. NMFS issued a final rule designating critical habitat for the Southern DPS of eulachon on October 20, 2011 (76 FR 65324). The designation includes the Klamath River from the mouth upstream to the confluence with Omogar Creek, but it excludes lands of the Resighini Rancheria and Yurok Tribe.

3.2.1.1.3. Southern Distinct Population Segment of Green Sturgeon

Green sturgeon (*Acipenser medirostris*) is an anadromous species that is known to range in near-shore marine waters from Mexico to the Bering Sea. NMFS has identified two distinct population segments: a northern coastal segment consisting of populations spawning in coastal watersheds northward of and including the Eel River and a southern segment consisting of coastal or Central Valley populations spawning in watersheds south of the Eel River. The Klamath River basin supports the largest spawning population of the species, which is included in the northern Distinct Population Segment (DPS) and also includes fish that spawn in Umpqua, Rogue, and Eel Rivers. Green sturgeon enter the Klamath River to spawn from March through July (NRC 2004). Most spawning occurs from the middle of April to the middle of June. Spawning takes place in the lower mainstems of the Klamath and Trinity rivers in deep pools with strong bottom currents.

Green sturgeon have been observed migrating into the Salmon River, but they are not thought to ascend the Klamath River beyond Ishi Pishi Falls (RM 66)(Moyle 2002, NMFS 2005). Juveniles stay in the river until they are 1 to 3 years old, when they move into the estuary and then to the ocean. Optimal temperatures for juvenile growth appear to be from 15 to 19°C, and temperatures above 25°C have been reported to be lethal (Mayfield 2002, as cited by NRC 2004). Outmigrant juveniles are captured each year in screw traps at Big Bar (RM 49.7) on the Klamath River and at Willow Creek (RM 21.1) on the Trinity River (Scheiff et *al*. 2001). After leaving the river, green sturgeon spend 3 to 13 years at sea before returning to spawn, and they often move long distances along the coast (NRC 2004).

Green sturgeon support small tribal fisheries by the Yurok Tribe in the Klamath River and the Hoopa Valley Tribe in the Trinity River. Although the Yurok and Hoopa Valley tribal catch has remained relatively constant in recent years, commercial and sport harvest has been greatly reduced by newly imposed fishing regulations in Oregon and Washington. In California, commercial fisheries for sturgeon are prohibited and regulations prohibiting the recreational harvest of green sturgeon took effect in March 2006.

NMFS published a final rule listing the Southern DPS as threatened (71 FR 17757; April 7, 2006). The Southern DPS includes Green Sturgeon populations south of the Eel River in Humboldt County. NMFS considers the Northern DPS, which includes the Klamath River population, a Species of Concern.

Non-listed Fish Species

The Klamath River Basin has native populations of steelhead and Chinook, neither of which is listed as a protected population under the ESA.

3.2.1.1.4. Upper Klamath-Trinity River and N. California Coastal Chinook Salmon

Fall and spring-run Chinook salmon upstream of the Trinity confluence are both considered to be part of the Upper Klamath-Trinity Rivers Chinook salmon ESU. NMFS considers fall-run Chinook salmon present downstream of the Trinity River-Klamath River confluence to belong to the SONCC Chinook salmon ESU. Neither ESU is currently listed under the ESA (77 Fed. Reg. 19597; April 2, 2012 and 64 Fed. Reg. 50394; September 16, 1999). Chinook salmon occur throughout the Klamath Basin in areas currently accessible to anadromous fish. Two runs of Chinook salmon are present in the basin with the more dominant life history being the fall run Chinook. Spring-run Chinook occur primarily in the Trinity and Salmon River watersheds. Fall-run Chinook numbers have declined over much of the last century, and spring-run Chinook, which were considered to be more abundant than the summer/fall-run fish prior to 1990, today consist of only remnant numbers (Hardy and Addley 2001). The total estimated catch and escapement of all Chinook salmon in the Klamath River between 1915 and 1928 averaged between 300,000 and 400,000 fish annually. Between 1978 and 1995, the average annual escapement of wild and hatchery-produced fall-run Chinook had declined to approximately 58,800 adults (Hardy and Addley 2001). The spring-run Chinook using the Salmon and Trinity subbasins, varied between approximately 200 and 1,500 adults per year between 1978 and 1995, and in 2002 was estimated to consist of just over 1,000 fish (Anderson 2003).

In 2008, the Pacific Fishery Management Council (PFMC) estimated the Klamath River Chinook run size at 70,572 adults with 13,552 adults returning to basin hatcheries. The estimate of spawning escapement to the upper Klamath River tributaries (Salmon, Scott, and Shasta Rivers), totaled 7,935 adults. In these three upper tributaries, escapement is not likely influenced by hatchery strays. The Shasta River has been the most historically important Chinook salmon spawning stream in the upper Klamath River, supporting an estimated spawning escapement of 30,700 adults as recently as 1964, and 63,700 in 1935 (PFMC 2008). The estimated escapement in 2008 to the Shasta River was only 2,741 adults, while escapement to the Salmon and Scott Rivers was 1,749 and 3,445 adults, respectively (PFMC 2008). Of the 2008 total Klamath River system estimate, 16,356 adults were estimated to be Trinity River origin with most of these spawning naturally. From 1999 to 2008, the peak estimated in-river run of Klamath River fall Chinook was in 2000 at 218,077 adults (PFMC 2008). Since 2007 the PFMC enacted significant reductions in ocean and in-river harvest of Chinook adults as the numbers of estimated natural adult spawners in the Klamath basin fell short of the 35,000 target. For 2012, fisheries managers are estimating that 381,000 fall Chinook may return to the Klamath River (PFMC 2012).

Fall-run Chinook salmon in the Klamath River typically spend less than a year in freshwater, a life history strategy that allows them to take advantage of streams in which temperature conditions may become unfavorable by late summer (Moyle 2002). The run peaks in early September and continues through late October (NRC 2004). Fall-run Chinook salmon reach their upstream spawning grounds within 2 to 4 weeks after they enter the river, after which they spawn and die. Spawning normally peaks during mid-October, and is complete by the middle of November (NRC 2004). Time to emergence is dependent on the temperature regime. In the main stem Klamath River, alevins can emerge from early February through early April, but peak times vary from year to year. After they emerge, fry disperse downstream, and many then take up residence in shallow water on the stream edges, often in flooded vegetation, where they may remain for various periods. As they grow larger, they move into faster water. Some fry, however, keep moving after emergence and reach the estuary for rearing.

Spring-run Chinook salmon typically exhibit a stream-type life history, meaning that the juveniles remain in streams for a year or more before they migrate to the ocean. Adult spring-run Chinook salmon typically enter freshwater before they are sexually mature, and hold in deep pools for 2 to 4 months before spawning. In California, this strategy allows salmon to spawn and develop in upstream reaches of tributaries that may be inaccessible to fall-run Chinook salmon because of low flows and higher temperatures in lower reaches during the summer and fall (Moyle 2002).

Spring-run Chinook salmon enter the Klamath system from April through July (NRC 2004). Spawning peaks in October. Fry emerge from redds between March and early June, and reside through the summer in cool headwater streams. Some juveniles may move downstream to the estuary as temperatures decline in October, although most do not migrate until the following spring (Hardy and Addley 2001). The number of wild spring Chinook returning to the Klamath River is generally less than 2,000 fish with combined hatchery and wild escapement infrequently exceeding 50,000 fish.

3.2.1.1.5. Klamath Mountains Province Steelhead

NMFS considers all steelhead in the Klamath River Basin to be part of the Klamath Mountains province ESU, which is not listed under the ESA (66 Fed. Reg. 17845; April 4, 2001). Historically, the Klamath River supported large populations of steelhead, the anadromous form of rainbow trout. Steelhead were distributed throughout the main stem and the principal tributaries such as the Shasta, Scott, Salmon, and Trinity River basins, and many of the smaller tributary streams. Steelhead runs in the Klamath River basin prior to the 1900s may have exceeded several million fish (Hardy and Addley 2001). Subsequent steelhead runs in the Klamath Basin declined steadily to an estimated 135,000 fish in 1977. Hardy and

Addley (2001) reported that in the 1980s, the hatchery-influenced summer/fall-run of steelhead throughout the Klamath Basin consisted of approximately 10,000 fish, while the winter-run steelhead component was estimated at approximately 20,000 fish.

In its most recent status review for the Klamath Mountains Province steelhead ESU, NMFS (2001) indicates that most California populations showed a precipitous decline to very low abundance around 1990 and stayed at low levels through 1999, but a modest increase in abundance was noted in 2000. Escapement estimates of summer steelhead to the Salmon River are consistent with the trend noted by NMFS, and in the Salmon River this increasing trend continued in 2002. The increased return of summer steelhead from 2000 to 2002 coincides with a period of strong returns of adult salmon and steelhead to the region caused by favorable ocean conditions that existed between 1998 and 2001. Information on the abundance of winter steelhead, which is considered to be the most abundant form, is very limited due to logistical difficulties in sampling adults during the winter season (NMFS 2001).

Moyle (2002) described two dominant life histories for this ESU, a summer run and a winter run. After entering the river, winter-run steelhead disperse throughout the lower basin and spawn mainly in tributaries but also show some main stem spawning. Spawning, which can take place any time from January through April, apparently peaks in February and March (NRC 2004). According to Moyle (2002), summer-run steelhead migrate upstream to the cool waters of the larger tributaries from late April through June. They typically hold in deep pools until December, when they spawn. Steelhead fry emerge from the gravel in the spring, and most spend 2 years in fresh water before going to sea. The rest spend either 1 or 3 years in fresh water (Hopelain 1998). Juvenile steelhead occupy virtually all accessible habitats in which conditions are physiologically suitable. Although spawning occurs mainly in tributaries, the juveniles distribute themselves widely, and many move into the main stem. Juveniles feed primarily on invertebrates, especially drifting aquatic and terrestrial insects, but fish (including small salmon) can be an important part of the diet of larger individuals. Aggressive 2- year-old steelhead (6 to 7 inches) often dominate in pools (NRC 2004).

Migrant sampling conducted from 1997 through 2000 at Big Bar on the Klamath River (RM 49.7) and at Willow Creek on the Trinity River (RM 21.1) indicates that the peak outmigration of steelhead smolts occurs from early April through mid- June in both rivers, with smaller numbers of steelhead smolts continuing to migrate through September, especially in the Trinity River (Scheiff et *al.* 2001). A majority of Klamath steelhead return to fresh water 3 to 4 months after their initial entry into salt water (as "half-pounders"). This life-history trait allows steelhead to consume eggs from the large numbers of Chinook salmon that enter the river in the fall (NRC 2004). Half-pounders usually stay in the lower main stem of the Klamath through March before they return to the sea to mature. Klamath steelhead spend 1 to 4 winters in the ocean before they return to spawn. About 30 percent of the steelhead in the Klamath spawn a second time after another year at sea, and about 5 percent survive to spawn a third time (Hopelain 1998).

3.2.1.1.6. Pacific Lamprey

Pacific lamprey (*Lampetra tridentata*) are found in Pacific coast streams extending from Alaska to Baja California. They currently occur throughout the mainstem Klamath River and its major tributaries downstream of Iron Gate Dam. The extent of their historical upstream distribution is uncertain due to the occurrence of several resident species of lamprey in the upper parts of the basin. Hamilton et *al*. (2005) note that Pacific lamprey are capable of migrating long distances, and generally show a similar distribution as anadromous salmon and steelhead.

Pacific lamprey are anadromous and, like salmon, die shortly after spawning. They enter the Klamath River at all times of the year and cease feeding as they migrate upstream. They spawn at the upstream edge of riffles in sandy gravel. Lamprey eggs hatch in approximately 2 to 4 weeks, and then the larvae (ammocoetes) drift downstream to backwater areas where they burrow into the substrate and commence feeding, tail embedded and head exposed, on algae and detritus (Kostow 2002). Juveniles remain in fresh water for 5 to 7 years before they migrate to the sea at a length of about 6 inches and transform into adults (Moyle 2002). They spend 1 to 3 years in the marine environment, where they parasitize a wide variety of ocean fishes, including Pacific salmon, flatfish, rockfish, and pollock. Their degree of fidelity to their natal streams is unknown (USFWS 2004). Adult Pacific lamprey typically range between 30 and 76 centimeters (12 and 30 inches) in length (Moyle 2002).

Larson and Belchik (1998) interviewed 20 Yurok tribal elders about the historic and current lamprey fishery in the Klamath River. Most of those interviewed reported daily catches as high as 300 to 1,500 lampreys per person per day before the run declined sometime between the late 1960s and the late 1980s. Reported catches since the decline have not exceeded 100 fish, with most respondents indicating that a catch of 20 lampreys was considered an extremely good catch. Pacific lamprey are collected regularly in screw traps fished in the Klamath at Big Bar and in the Trinity River at Willow Creek.

Pacific lamprey also use or could use the Klamath River for spawning and rearing. The National Research Council (2003) reported that Pacific Lamprey was once very abundant in the California coastal rivers, but today their numbers are low and declining. Hardy and Addley (2001) reported no quantitative data are available on the status of Pacific lamprey, although their distribution is believed to be generally similar to that of steelhead.

3.2.2. Fish Habitat

The area of affected fish habitat encompasses the main stem Klamath River below IGH. This area includes critical habitat for the SONCC coho salmon ESU and Pacific Coast Salmon Essential Fish Habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act (Appendix A of Amendment 14 to Pacific Coast Salmon Plan, January 1999). Critical habitat for the SONCC coho salmon ESU includes all accessible waterways, substrate, and adjacent riparian zones between the Mattole River in California, and the Elk River in Oregon, inclusive (64 Fed. Reg. 24049; May 5, 1999). Excluded are: (1) areas above specific dams identified in the Federal Register notice; (2) areas above longstanding natural impassible barriers (i.e., natural waterfalls); and (3) tribal lands. In the Klamath Basin, EFH has been designated for the main stem Klamath River and its tributaries from Iron Gate Dam to the mouth. It includes the water quantity and quality conditions necessary for successful adult migration and holding, spawning, egg-to-fry survival, fry rearing, smolt migration, and estuarine rearing of juvenile coho and Chinook salmon. In addition, NMFS issued a final rule designating critical habitat for the Southern DPS of eulachon on October 20, 2011 (76 FR 65324). The designation includes the Klamath River from the mouth upstream to the confluence with Omogar Creek at about RM 8.

The analysis in this EA focuses on salmon habitat (including critical habitat) because those are the fish species most directly affected by the alternatives. The biological requirements for salmon are the habitat characteristics that support successful adult spawning, embryonic incubation, emergence, juvenile rearing, holding, migration and feeding. Generally, during salmonid spawning migrations, adult salmon prefer clean water with cool temperatures and access to thermal refugia, dissolved oxygen (DO) near 100 percent saturation, low turbidity, adequate flows and depths to allow passage over barriers to reach spawning sites, and sufficient holding and resting sites. Anadromous fish select spawning areas based on species-specific requirements of flow, water quality, substrate size, and groundwater upwelling (Sandercock 1991). Embryo survival and fry emergence depend on substrate conditions (e.g., gravel size, porosity, permeability, and DO concentrations), substrate stability during high flows, and, for most species, water temperatures of 14ºC or less (Quinn 2005). Habitat requirements for juvenile rearing include seasonally suitable microhabitats for holding, feeding, and resting (Moyle 2002).

Migration of juveniles to rearing areas requires access to these habitats. Physical, chemical, and thermal conditions may all impede movements of adult or juvenile fish (Moyle 2002). Below we provide a summary of the condition of essential habitat types for salmon in the affected area. This information is largely drawn from a recent biological opinion on effects of the Bureau of Reclamation's Klamath Project on coho salmon in the Klamath River (NMFS 2010).

3.2.2.1. Juvenile Summer and Winter Rearing Areas

In the affected area, juvenile summer rearing areas for salmon have been affected by low flow conditions, high water temperatures, insufficient dissolved oxygen levels, excessive nutrient loads, habitat loss, disease effects, pH fluctuations, non-recruitment of large woody debris, and loss of geomorphological processes that create habitat complexity. Water temperatures in the Klamath River downstream from Iron Gate Dam during summer months are potentially stressful to juvenile salmon (NRC 2004). The temperature of water released from Iron Gate Dam reaches a maximum of about 22ºC in August with minor diel change. By the time this water reaches Seiad Valley (RM 130), maximums are greater than 26ºC, and minimums are 22ºC (NRC 2004). Nocturnal DO levels directly below Iron Gate Dam can fall below 7.0 mg/L and could be stressful to coho salmon juveniles during much of the late summer and early fall. Between Iron Gate Dam and Seiad Valley, daily maximum pH values in excess of 9.0 have been documented, as high primary production within the weakly buffered Klamath River basin causes wide diurnal pH fluctuations (PacifiCorp 2006). Riparian recruitment within the first several miles below Iron Gate Dam is likely impaired by the typically fast recession of the spring hydrograph, because the roots of newly established vegetation are unlikely to keep up with the rapidly lowering water table (FERC 2006). This can limit the amount of cover available to rearing coho salmon. Although sediment recruitment in the Klamath River upstream of Iron Gate Dam is limited, dams nonetheless impair gravel and fine sediment recruitment downstream of PacifiCorp's Project reservoirs, which contribute to poorly functioning floodplains that fail to support healthy riparian recruitment. Winter rearing areas suffer from non-recruitment of large woody debris and stream habitat simplification for a number of reasons, including the dams and restrictions on movement of large woody debris due to the existence of a road on one side of the river.

3.2.2.2. Juvenile Salmon Migration Corridor

In the Upper Klamath River reach, juvenile salmon migration corridors have been affected by low flow conditions, disease effects, high water temperatures and low water velocities that slow and hinder emigration or upstream and downstream redistribution. The unnatural and steep decline of the hydrograph in the spring may slow the emigration of coho salmon smolts, speed the proliferation of fish diseases, and increase water temperatures more quickly than would occur otherwise. Disease effects (primarily due to the myxosporean *Ceratomyxa shasta*) likely have a substantial impact on the survival of juvenile coho salmon in the main stem Klamath River. Disease rates increase substantially with distance from the dam, peak at approximately RM 173, then decrease again in the lower Klamath River.

3.2.2.3. Adult Migration Corridor

The current physical and hydrologic conditions of the adult salmon migration corridor in the Upper Klamath River reach likely functions in a manner that supports its intended conservation role. Water quality is suitable for upstream adult migration, and flow volume is above the threshold at which physical barriers may form.

3.2.2.4. Spawning Areas

Coho salmon are typically tributary spawners, however, low numbers of adult salmon do spawn in the Upper Klamath River reach annually. Upstream dams block the transport of sediment into this reach of river. The lack of clean and loose gravel diminishes the amount and quality of salmonid spawning habitat downstream of dams. This condition is especially prevalent immediately below Iron Gate Dam (FERC 2006). Water temperatures and water velocities are generally sufficient in this reach for successful adult coho salmon spawning.

3.2.3. Fish-Eating Birds

3.2.3.1. Bald Eagle

Bald eagles (*Haliaeetus leucocephalus*) occur in North America from central Alaska and Canada south to northern Mexico (USFWS 1995). They are found primarily along coasts, inland lakes, and large rivers, but may also be found along mountain ranges during migration. Although the bald eagle is greatly reduced in abundance from historical levels, the current distribution is essentially the same (USFWS 1976). Many bald eagles withdraw in winter from northern areas, migrating north again in spring and summer to breed (Terres 1980). They generally nest in large old growth trees near ocean shore, lakes, and rivers. They require open water habitats that support an adequate food base. Bald eagles forage on fish and waterfowl from perch sites adjacent to foraging areas.

In the Klamath Province, which includes the area above and below Iron Gate dam, bald eagles typically nest in very large, emergent trees that may or may not be associated with dense older stands. Nest sites are usually associated with rivers, but may be located on steep mountainsides or drainages over a mile from aquatic habitats used for foraging. During winter, bald eagles often congregate near productive foraging areas (e.g., Project reservoirs and the Klamath River) and use communal roost sites. Bald eagles are known to nest and overwinter along the Klamath River.

3.2.3.2. Osprey

The osprey (*Pandion haliaetus*) breeds in northern California from Cascade Ranges south to Lake Tahoe, and along the coast south to Marin County. Regular breeding sites include Shasta Lake, Eagle Lake, Lake Almanor, and other inland lakes and reservoirs (CDFW 2011). Ospreys are found only in association with lakes, reservoirs, coastal bays, or large rivers. They feed predominantly on fish, although some mammals, birds, reptiles, and amphibians are also eaten. Ospreys require open, clear water for foraging, and swoop down while in flight or from a perch to catch fish at the water’s surface. Large trees and snags near the water are used for roosting and nesting. This species nests on a platform of sticks at the top of large snags, dead-topped trees, on cliffs, or on human-made structures. Nests may be as much as 250 feet above ground. During the breeding season, ospreys generally restrict their movements to activities in and around the nest site, and between the nest and foraging sites.

Ospreys can forage along streams in nearly all forested landscapes, but larger, denser stands are more suitable for foraging. Habitat suitability for cover and reproduction is maximized in stands with large trees (CWHR size classes 4, 5 and 6) in the Klamath Mixed Conifer and similar forest types regardless of canopy density. However, stands with slightly smaller trees (CWHR size class 3) provide at least moderate suitability for cover and reproduction of this species. Ospreys are known to use riparian forests near the Klamath mainstem.

3.3. Cultural Resources, Socioeconomics, and Environmental Justice

3.3.1. Cultural Resources

Cultural sites associated with IGH were described in the recent CDFW Hatchery and Stocking Program EIR/EIS (ICF Jones & Stokes 2010) and that information is summarized here. The cultural resources inventory that was used included a records search, a review of archival information, and Native American consultation. The records search was conducted in December 2008. No prehistoric or archaeological resources were recorded within the IGH area. One historic site was identified within 0.25 mile of the hatchery area. It consists of a rock wall, partially collapsed, and was recorded in 2003. One multi-component resource was identified within 0.25 mile of the hatchery area. This site consists of a single rock shelter, a small lithic scatter, and some historic debris (ceramics, glass, and metal fragments). It was recorded in 2003. As described below, none of these cultural resources will be impacted by the proposed action.

3.3.2. Socioeconomic Environment

IGH is located in Siskiyou County, California. The most current U.S. Census data from 2010 indicates that Siskiyou County has a population of 44,900 people, with race and ethnicity distribution of 79.5 percent White, 10.3 percent Hispanic[7], and 20.5 percent Racial Minority[8].

There are five Federally-recognized Native American tribes within the Klamath River basin downstream of Iron Gate Dam (San Diego State University 2011). They are:

- The Quartz Valley Indian Community includes a federal reservation of Klamath, Karuk, and Shasta Indians in northwestern California near the community of Fort Jones, Siskiyou County, California. The total reservation area today is about 174 acres.
- The Karuk Tribe, which is today one of the largest tribes in California, has a small land base, with most of the Karuk Tribe living in Humboldt and Siskiyou counties, California, and in southern Oregon.
- The Yurok Indian Reservation encompasses 56,585 acres located 1 mile on either side of the Klamath River from the mouth at the Pacific Ocean upstream 22 miles, extending through Del Norte and Humboldt counties, California.
- The 85,446-acre Hoopa Valley Indian Reservation is located along the Trinity River in northeast Humboldt County, California.
- The Resighini Rancheria is a 228-acre federal reservation of Karuk Indians in Del Norte County, California. The reservation spans the mouth of the Klamath River.

The U.S. Bureau of Labor Statistics database indicates an average unemployment rate of 19 percent in Siskiyou County between January 2010 and January 2011. Total per capita personal income is approximately $42,000. The hatchery currently employs seven permanent positions, which include a Fish Hatchery Manager II, Fish Hatchery Manager I, Office Technician, Fish and Wildlife Technicians (4) and seasonal personnel when funds are available.

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[7] Hispanics may be of any race.

[8] Racial Minority includes individuals who report a race other than White Non-Hispanic.

PacifiCorp constructed IGH and historically supplied 80 percent of the annual operating cost while CDFW contributed 20 percent of the annual budget. Starting in 2010 PacifiCorp began funding 100 percent of hatchery operations and maintenance costs pursuant to the KHSA. PacifiCorp will continue to fund IGH and implementation of the HGMP, the costs of which PacifiCorp will seek to recover from its customers in the six western states it serves.

3.3.3. Recreation

The lower portion of the Klamath River, beginning at 3,600 feet downstream of Iron Gate dam to the Pacific Ocean (about 189 miles), was designated as a national Wild and Scenic River by Congress in 1981. There are 286 miles (including portions of the Salmon and Scott rivers and Wooley Creek) of which 12 miles are classified as "wild," 24 miles as "scenic," and 250 miles as "recreational." The Outstanding Recreation Value (ORV) for this river is anadromous fisheries (steelhead and salmon). The importance of anadromous fisheries extends into cultural, recreational, and socioeconomic resources.

The Klamath River and the Project reservoirs support a number of recreational pursuits, including boating (standard and whitewater), sport fishing (private and commercial), camping, and day use. Most of the developed recreational capacity in the vicinity of IGH is located at Iron Gate reservoir. There are campgrounds, day use areas, boat launches, and a scenic overlook. Among all of the Project reservoirs, Iron Gate reservoir is the most popular for boating; existing peak use boating density is at 47 percent of the theoretical maximum density. At IGH, there is a day-use area adjacent to the hatchery with tables, an interpretive kiosk, restrooms, parking area, and an ADA-accessible trail to the river/fish return area. There is public access to the river with a graveled road to the shoreline for launching small boats located on the northwest side of the river (accessed from Copco Road).

The Klamath River downstream of Iron Gate Dam has high quality angling opportunities extending nearly 200 miles to the Pacific Ocean. The main Klamath River from 3,500 feet downstream of Iron Gate dam is open to fishing year round. This reach attracts and supports several fishing outfitter services that focus on salmon, steelhead, and trout fisheries. However, angling in the Lower Klamath River is dependent on the annual status of the fall-run Chinook salmon run, so the number of businesses that offer angling guide services changes from year to year. Low returns of adult Chinook spawners in both the Klamath River and Sacramento River have been the basis for recreational fishing restrictions in some years.

Recreational fishing effort in California was up substantially in 2010 as compared to 2009 effort levels since the sport fishery was not restricted in 2010 to a 10-day fishery in the Klamath Management Zone as it was in 2009. However, given the improvements in recreational fishing opportunities in 2010, fishing effort was still severely depressed compared to historical levels (PFMC 2011). For the 2010 fishing year, it is estimated approximately 5,000 Chinook were taken in the in-river recreational harvest, which is below an average of 10,000 for the years 1978-2010 (CDFW 2011a). For all of California, 14,697 Chinook were caught in the 2010 recreational fishery from a total of 48,757 fishing trips, for a success rate of less than one fish per trip (PFMC 2011). Although there were increases in 2010 Chinook salmon adult returns and natural spawner escapement, recreational fishing catches remain depressed.

The Klamath River downstream of Iron Gate Dam also has extensive boating opportunities. Whitewater boating opportunities exist mainly on the 123-mile segment of the Klamath River from downstream of Iron Gate Dam to the confluence with the Salmon River. Standard boating opportunities are available in most reaches depending on access.

3.3.4. Commercial Fishing

Chinook salmon continues to be the most abundant salmonid species present in the Klamath River basin and supports important commercial, recreational, and tribal fisheries. The commercial fishing fleet within the Klamath Management Zone (KMZ) boundaries consists of ships that generally fish in waters relatively close to their home ports and land their catch at ports close to the waters where the fish are caught. This fleet catches fish originating from the Klamath River. Reductions in fish produced in the Klamath can impact the KMZ commercial fishery. The KMZ falls under the jurisdiction of the states of California and Oregon, as well as PFMC. The PFMC tracks fish landings and fishing efforts by port, and generally publishes data for major port areas. The major port areas in the KMZ include Brookings in Oregon and Crescent City, Eureka, and Fort Bragg in California.

Historically, significant Chinook salmon and coho salmon fisheries used the waters now designated as the KMZ. The harvest levels of Klamath River fall Chinook (KRFC) salmon in the KMZ were much higher in the mid- to late-1980s (in the tens of thousands of fish) than in the 1990s (in the tens or hundreds of fish). The harvest level recovered somewhat from 2001 to 2005, with the catch in the range of 1,400 to 3,900 fish. This pattern in Klamath River fall Chinook salmon harvest levels, coupled with changes (both up and down) in the ex-vessel price of all salmon caught in the KMZ, has been mirrored in the personal income received by commercial fishermen in the KMZ.

Since 2008, Klamath stocks have experienced reduced impacts from the mixed-stock ocean salmon fishery, as a result of management measures designed to protect continued low returns of Sacramento River fall-run Chinook salmon (SRFC). Despite widespread salmon fishery closures in 2008 and 2009, the 2010 abundance forecast of SRFC was the third lowest on record, with only 2008 and 2009 values being lower. As a result, the PFMC recommended very restrictive salmon fisheries south of Cape Falcon, Oregon again in 2010. Only two 4-day openings in early July were available for commercial fishing in California and no fall commercial fisheries were established south of Cape Falcon due to concerns over the status of SRFC. Retention of coho in the ocean salmon fishery off California was prohibited again in 2010, in accordance with ESA consultation standards designed to reduce fishery impacts on Klamath Basin coho salmon.

In recent years, the commercial Chinook ocean fishery in California has been severely impacted due to low adult returns in the Sacramento and Klamath River systems. In 2010 California had its first commercial salmon fishery since 2007, although it remained heavily constrained by SRFC management objectives. The ex-vessel value of the California commercial ocean salmon catch in 2010 was $1.2 million compared with (inflation adjusted) $8.2 million in 2007 and a 1979-2009 average of $17.7 million (inflation adjusted) (PFMC 2011). In 2010, 216 vessels made salmon landings in California compared with zero vessels in 2008 and 2009. In 2007, there were 601 vessels active in California, compared with 477 vessels active in 2006 (PFMC 2011).

3.3.5. Tribal Fishing

In addition to tribal cultural and ceremonial fishing in the basin, commercial harvest of Chinook salmon also occurs. Data from PFMC (2011) for the in-river tribal fishery harvest (commercial and subsistence) of the Yurok and Hoopa estimates of both fall and spring-run Chinook adults in the Klamath River basin for 2008 is 22,901, 2009 is 28,565, and 2010 is estimated at 30,432. The 2010 estimates are above average tribal harvest catch in the Klamath basin for the years 1978-2010 (CDFW 2011a).

3.3.6. Land Ownership and Land Use

PacifiCorp owns the land adjacent to the IGH, Iron Gate Dam, and powerhouse, as well as most of the land along the Iron Gate reservoir shoreline and the nearby transmission line right-of-way.

In the Klamath River basin area in the vicinity of IGH, the land ownership is dominated by federal lands including the Klamath, Modoc, and Shasta National Forests, National Wildlife Refuges, Lava Beds National Monument, and small parcels owned by the U.S. Bureau of Land Management. Land ownership grows in private ownership near the City of Yreka, and in the Scott and Shasta River watersheds, which include private lands used primarily for timber production and agriculture. Private land use jurisdiction and management in the Klamath River basin area in the vicinity of IGH falls mainly within the jurisdiction of Siskiyou County.

4.ENVIRONMENTAL CONSEQUENCES

This section provides the scientific and analytic basis for comparing the two proposed alternatives. It includes a discussion of the probable consequences of the two proposed alternatives on environmental resources. All resource impacts from a single alternative are presented under the discussion of that alternative. Resources that could be impacted and are part of this environmental analysis include water resources (i.e., hydrology and water quality), biological resources (including fish species and fish-eating birds), cultural resources, socioeconomics and environmental justice. Differences between the No Action and Proposed Action alternatives are primarily related to incremental biological improvements as a result of full implementation of the HGMP over the next ten years. As discussed previously, the environmental impacts from both alternatives are not expected to extend beyond 10 years. However, changes in operations to IGH would likely occur in 2020 should removal of the hydroelectric facilities be approved, as described in the KHSA, and these changes would likely trigger the development of amendments to the Section 10(a)(1)(A) permit.

4.1. Effects from Alternative 1 (No Action)

4.1.1. Effects on Water Resources

Under Alternative 1 (No Action), NMFS would not issue an ESA section 10(a)(1)(A) permit. Under the No Action alternative, full implementation of the HGMP would likely not occur because take of listed coho to support artificial propagation efforts may cease as described in Section 2.1 above. However, operations at IGH that would not result in the take of coho salmon would likely continue to occur, with fish production for non-listed salmonids occurring at levels similar to current levels.

4.1.1.1. Hydrology

Water for IGH operations is supplied from Iron Gate Reservoir. During daily operations, flows ranging from 7.75 to 34.9 mgd (12.0 to 54.0 cfs) pass through the IGH facilities and discharge into the Klamath River. Under Alternative 1 (No Action), this level of water use would continue. This level of continued water use is not expected to have a significant effect on hydrologic conditions and resources. No appreciable consumption of water will occur under Alternative 1 since water diverted to IGH from Iron Gate Reservoir is returned to the river. Also, the amount diverted is small relative to the total river flow (less than 1 percent), and causes no effects on other water uses in the short reach (about 0.5 miles) of the Klamath River between the IGH water intake in Iron Gate Reservoir and the return discharge from IGH.

4.1.1.2. Water Quality

Under Alternative 1 (No Action), impacts on water quality would continue as they currently occur. Water discharged from IGH into the Klamath River would continue to contain contaminants generated during the feeding and care of the fish produced in the hatchery. Water used at IGH would continue to be put through the settling ponds, and treated water would be discharged into the Klamath River. The water quality characteristics of the discharge with regard to nutrients and organic matter would likely be unchanged from current conditions. For example, the North Coast Regional Water Quality Control Board (NCRWQCB) Total Maximum Daily Load (TMDL) analysis found that nutrient loading due to IGH operations through the raceways and settling ponds is approximately 2,109 lbs of total nitrogen and 567 lbs of total phosphorous. These results indicate that the hatchery is a relatively minor source of nutrients to the Klamath River. Organic matter loading of hatchery operations was not estimated in the

TMDL analysis but is also expected to be minor. Therefore, Alternative 1 is not expected to result in significant impacts to nutrients and algae in the Klamath River.

Under Alternative 1 (No Action), the characteristics of the IGH discharge with regard to other water quality constituents also would likely be unchanged from current conditions. CDFW would continue to operate the IGH pursuant to an individual National Pollutant Discharge Elimination System (NPDES) permit issued by the NCRWQCB to both CDFW and PacifiCorp (NPDES Permit No. CA 0006688, WDID 1A800520SIS). The NCRWQCB permit establishes conditions for the IGH discharge to maintain compliance with the Clean Water Act including adherence to water quality standards that establish limits or prohibitions on direct discharge of effluent containing detectable levels of potential contaminants to the Klamath River. The NPDES permit and the standards outlined in the NPDES permit were developed to be protective of designated beneficial uses (including salmonids rearing, spawning, and migration), so it is expected that the hatchery effluent will have a negligible impact on Klamath river water temperatures, pH, and DO under Alternative 1. This conclusion is consistent with Item 11 under the existing permit, where the Regional Water Board considers the discharge to have very low potential to cause nonattainment of toxicity standards due to minimal chemical treatment of fish and high discharge dilution in the receiving waters. In addition, the NPDES permit requires a chemical pollutant scan under the California Toxics Rule every five years. The scan was last performed and submitted in 2007, and did not identify any chemicals discharged from IGH above background levels. Therefore, Alternative 1 is not expected to result in significant impacts to other water quality constituents in the Klamath River.

4.1.2. Effects on Biological Resources

4.1.2.1. Anadromous Salmonid Species

Under Alternative 1 (No Action) as described in section 2.1, if NMFS does not issue the ESA Section 10(a)(1)(A) permit, CDFW and PacifiCorp would have to decide how to proceed in implementing the coho salmon program at IGH, and it is unclear at this point how all of the elements of the program would be implemented. Hatchery propagation of coho salmon requires the lethal take of adult coho salmon for broodstock and the loss of individuals during incubation, rearing, and marking. Under Alternative 1, there would be no authorized take of listed coho salmon at IGH. Without take authorization, collection and handling of listed coho salmon may cease, and other sources of hatchery broodstock would need to be identified (see sections 2.1 and 4.1.1). However, it is unclear whether collection and handling of listed coho salmon would cease, and, if it does cease, what other sources of hatchery broodstock might be identified. For purposes of analysis and comparison under this EA, this section will analyze effects that are expected if the program were to continue as it currently does, because NMFS has available information regarding effects of current operations. Under those circumstances, the program would collect enough adult coho broodstock each year to produce 75,000 smolts (between 135-270 adults). Of the fish needed for broodstock, 20 to 50 percent (27 to 135 adults) would be NOR. Adults may enter the facility and not be used for broodstock; the handling and release of these adult coho back to the river may result in injury or mortality. It is expected that less than 1 percent of the fish collected and released will suffer injury sufficient to result in mortality (Keith Pomeroy, Hatchery Manager II, pers. comm. 2012).

Once broodstock are collected, coho eggs are incubated and reared to age-1. Egg to yearling survival has averaged 32 percent over the past four years. This is expected to increase with changes implemented beginning in 2010 including the addition of bird netting to raceways, decreases in egg densities during incubation, the installation, in 2011, of a moist air incubation system for coho egg rearing, and decreases in hatchery inbreeding. It is expected that in-hatchery survival from egg to yearling will exceed 50 percent. The total smolt production is expected to remain at 75,000 smolts per year. Additional surplus smolts produced at the hatchery would be released into the Klamath River.

One of the major impacts of hatchery propagation at IGH is the genetic and demographic consequences of inbreeding. Inbreeding results when closely related adults are spawned at the hatchery. When inbreeding occurs, survival of progeny is decreased. The high degree of inbreeding in the coho salmon program has resulted from a number of factors including small program size, the avoidance of jacks (grilse) in the broodstock, and the lack of a genetic broodstock management program at the hatchery.

Under Alternative 1, the potential for indirect impacts to naturally-spawned juvenile salmon would likely result from competitive and predatory interactions, disease transfer, and interbreeding between HOR and NOR individuals in the Klamath River. Interactions occur between HOR coho salmon and NOR coho salmon, Chinook, and steelhead. These interactions are an indirect impact of the coho salmon program at IGH and result in both positive and negative effects on salmon populations.

Predation – Predation of NOR fry by hatchery yearlings has been reported in previous studies (Allee 1981, Larkin, 1956, Naman 2008). Based on the time and size at release, hatchery coho salmon yearlings may prey on naturally-produced coho, steelhead, and Chinook fry. With regard to coho, there is no specific data on the impact HOR coho predation may be having on NOR coho populations in the Klamath. Some of the hatchery coho salmon yearlings reside in the Klamath River above Big Bar for approximately 1.5 to 2 months and then migrate quickly to the ocean (CDFW 2003). The time period of likely predatory impacts is from March to May. During this time there is the potential they may prey on subyearling NOR coho salmon. The impacts of this predation are expected to be relatively minor given the small number of fry in the main stem at the time when yearling HOR coho would be migrating and the relatively low number of HOR coho released from IGH. This assumption is consistent with modeling results presented in the HGMP, which showed that hatchery coho induced mortality on naturally produced coho from predation, competition and disease was less than 6 percent.

With regard to steelhead and Chinook, the impact of predation depends, in part, on the prey population size, that is, the effect of predation on small populations could be potentially significant. Given the small population abundance of natural coho populations, predation by hatchery fish could have a substantial impact some years. The larger population sizes of Chinook and steelhead in the Klamath indicate that hatchery predation may impact these species less.

Competition – Similar to the impacts of predation there is potential for competition between HOR coho salmon and NOR coho, Chinook and steelhead. Flagg et *al*. (2000) found that, except in situations of low fish density, increasing release numbers of hatchery fish can negatively impact naturally produced fish because naturally produced fish can get displaced from portions of their habitat. Competition between hatchery and naturally produced salmonids can also lead to reduced growth of naturally produced fish (McMichael et *al*. 1997). Competition between hatchery and natural salmonids in the ocean has also been shown to lead to density-dependent mechanisms that affect natural salmonid populations, especially during periods of poor ocean conditions (Beamish et *al*. 1997, Levin et *al*. 2001, Sweeting et *al*. 2003). In the Klamath River the most significant impact from competition likely occurs as result of competition for space in refugia and rearing habitat in the main stem and tributaries. The potential for adverse effects on natural coho salmon populations is highest in late spring when lower flows and higher water temperatures may increase competition for suitable rearing habitat (Joint Hatchery Review Committee 2001). Because the release of HOR yearling from the hatchery coincides with the migration of NOR coho, Chinook, and steelhead, there is the potential for competition in areas where there is limited rearing or migratory habitat (such as the Lower Klamath). There is not expected to be competition between adult HOR coho salmon and NOR adult salmon for spawning habitat. This is because of low salmon abundances on the spawning grounds and adequate spawning habitat in the

Klamath. Competition between IGH juveniles and NOR juveniles is also expected to be low given the short residence time (< 22 days) of HOR yearling in the river and the low number of IGH coho yearling released (75,000).

Disease –Currently, CDFW certifies the health and disease status of coho salmon prior to release and disease has not been an issue for coho salmon at IGH. Under Alternative 1, as under the current hatchery program, there are not expected to be disease effects on NOR salmon from the direct release of juvenile coho.

Interbreeding – Spawning by IGH hatchery coho salmon is not controlled on the spawning grounds of the Klamath River. Under Alternative 1, this would not change and interbreeding between HOR coho from IGH and NOR coho salmon is likely to continue in the Upper Klamath, Scott, and Shasta populations. Other populations are known to experience negligible coho straying from IGH. When hatchery fish stray into natural populations they transfer genes from hatchery populations into naturally spawning populations (Pearse et *al*. 2007). This is thought to be problematic because hatchery programs alter the genetic composition (Reisenbichler and Rubin 1999, Ford 2002), phenotypic traits (Hard et *al*. 2000, Kostow 2004), and behavior (Berejikian et *al*. 1996, Jonsson 1997) of natural populations. These genetic interactions between hatchery and naturally produced stocks decrease the amount of genetic and phenotypic diversity of a species by homogenizing once disparate traits of hatchery and natural fish. The result has been progeny with lower survival (McGinnity et *al*. 2003, Kostow 2004) and ultimately, a reduction in the fitness of the natural stock (Reisenbichler and McIntyre 1977, Chilcote, 2003, Araki et *al*. 2007) and outbreeding depression (Reisenbichler and Rubin 1999, HSRG 2009).

Under the current hatchery program, it is expected that there would remain a low proportion of natural influence in the hatchery brood stock, assuming that the hatchery program would continue as it does currently. However, as discussed above, it is unclear that without take authorization under Section 10(a)(1)(A), collection and handling of listed coho salmon would continue, and other sources of hatchery broodstock may need to be identified. The Proportionate Natural Influence (PNI) measures gene flow between HOR and NOR fish, and is calculated by determining the proportion of NOR fish in the hatchery brood stock (pNOB) and dividing this by the proportion of natural spawners in the stream comprised of HOR fish (pHOS) plus the percent NOR fish in the hatchery brood stock (pNOB) (HSRG, 2009). In the analysis of the current coho salmon program (which is discussed under Alternative 1), HOR adults on the spawning grounds were found to make up anywhere between 10 and 47 percent of the total spawning population. Under current conditions, pNOB would be 10 percent, as this is the current target for the IGH program. The large proportion of hatchery fish on the spawning grounds results in a PNI of ~0.17. This value is far below the HSRG recommended value of 0.67 for biologically important populations (HSRG 2009). In short, the combined natural and hatchery population genetics are being driven more by the hatchery than the natural environment, thereby reducing population fitness to 0.50 (0.5, lowest score possible). A summary of biological metrics for the current hatchery program are provided in Table 1[9].

Table 1. Summary of Alternative 1 (No Action) IGH coho salmon program escapement, harvest, broodstock and HSRG performance indicators of PNI and pHOS (productivity and capacity of 2.3 and 800) (This table is reproduced from the HGMP: Table A-3).

[9] If collection and handling of listed coho salmon were not authorized under Alternative 1, it would likely be necessary for out-of-basin coho salmon to be used as broodstock for a hatchery coho salmon program to continue. In this instance, the hatchery coho program would be a segregated program, and the pNOB would be 0, resulting in a PNI of 0. This would be inconsistent with HSRG recommendations.

		Max	Min	Ave
Escapement (adults)		734	71	228
HOR Total Escapement (plus strays)		289	50	94
HOS Effective Escapement		231	40	76
Total Natural Escapement (& All HOS)		1,023	130	322
Hatchery Broodstock		212*	212	212
Surplus at Hatchery		2,731	308	759
Total Run-size		4,219	685	1,376
PNI		0.17		
pHOS		25%		
Population Fitness (range 0.5 to 1)		0.50		

* Assumes that the program collected more eggs than required to meet juvenile release targets. Surplus eggs are culled at the eyed egg life-stage.

Although risks from hatchery interbreeding would be expected under Alternative 1, there could also be benefits from maintaining hatchery production. If natural populations are too small without the input of hatchery spawners they can experience depensation, or the negative genetic impacts of small population size (e.g., inability to find mates, inbreeding). It is expected that Alternative 1 could benefit the Upper Klamath and Shasta populations through the contribution of strays. These two populations currently fall below the depensation thresholds set by Williams et *al.* (2008). At these abundances they are experiencing depensation. The coho salmon program at IGH contributes approximately 10-50 percent of the spawners to these populations depending on the return year and under Alternative 1 this level of straying would likely continue. The benefits from spawning contributions are at least partially offset by the negative characteristics of hatchery spawners discussed above but the influx of spawners to these populations is a net benefit to these populations given their low natural abundance.

4.1.2.2. Anadromous Salmonid Habitat

4.1.2.2.1. Juvenile Summer and Winter Rearing Areas

Under Alternative 1 (No Action), effects on juvenile summer and winter rearing area could occur from the presence of hatchery fish. The amount of food in some areas could be limited at certain times of the year by hatchery fish. Space for rearing juveniles and fry could be limited by hatchery fish, particularly during low-flow periods in late summer.

4.1.2.2.2. Juvenile Migration Corridor

Under Alternative 1 (No Action), effects on juvenile migration corridor habitats could occur from the presence of hatchery fish. Food, space, and cover could be limited in certain months and in certain areas (such as thermal refugia) due the presence of hatchery juveniles. Alternative 1 could continue to limit the function of important habitat in the juvenile migration corridor due to reductions in food and space resulting from the presence of juvenile hatchery fish from March to May.

4.1.2.2.3. Adult Migration Corridor

There are expected to be little, if any, impacts to the adult migration corridor as a result of Alternative 1. At the time when adult hatchery coho return to the hatchery and spawning grounds, there is adequate migratory habitat to support salmon. There is therefore little if any competition between HOR coho and NOR salmon for migratory habitat.

4.1.2.2.4. Spawning Areas

There are expected to be little, if any, impacts to spawning habitat as a result of Alternative 1. There is expected to be adequate habitat to support HOR and NOR salmon on spawning grounds. None of the spawning areas where IGH coho stray are at, or near, carrying capacity. There is therefore little, if any, impact of HOR coho on natural spawning grounds.

4.1.2.3. Other Fish Species

4.1.2.3.1. Eulachon

Eulachon abundance in the Klamath River have decreased to the point where detecting them in the Klamath River has become difficult (NMFS 2010). In winter, eulachon enter the Klamath River to spawn, but do not migrate beyond the estuarine habitat within the lower several miles of the Klamath River. In contrast, IGH (and its associated coho salmon program) is located about 190 miles upstream of the estuary. Therefore, because of the location of the hatchery, the physical hatchery operations needed for fish culture under the No Action alternative are unlikely to significantly affect eulachon (NMFS 2010)

Adult coho salmon may prey on eulachon in the marine and estuarine environments (NMFS 2006). Therefore, adult coho produced by the program may consume some eulachon during their ocean migration. However, given the number of hatchery adults produced by the program (less than 1,500 on average) and the large prey base of other species available for coho salmon to consume in the ocean, it is unlikely that coho salmon produced by the program would significantly affect eulachon.

4.1.2.3.2. Green Sturgeon

Northern DPS green sturgeon (Species of Concern) enter the Klamath River between March and July to spawn and some adults remain in river until the first fall freshets trigger emigration downstream. Green sturgeon are not thought to ascend the lower Klamath River beyond Ishi Pishi Falls at RM 66 (NMFS 2005) which is about 125 miles downstream of IGH. IGH operations are not expected to significantly affect the physical, chemical and biological conditions within the lower Klamath River. Additionally, the Biological Review Team (BRT) noted that current threats to Klamath River green sturgeon are increased river temperatures, reduced oxygen concentrations, and the alteration of the river flow regime (NMFS 2005). Salmon hatchery operations or production were not listed as a threat to green sturgeon in any river examined by the BRT. Because of the upriver IGH location, and recognition by the BRT that hatchery production does not pose a threat to green sturgeon in the lower Klamath River, the No Action alternative is not likely to significantly affect green sturgeon.

4.1.2.3.3. Pacific Lamprey

Adult Pacific lamprey enter the Klamath River at all times of the year to spawn, but cease feeding and die shortly after spawning. The No Action alternative is not expected to affect the physical, chemical and biological conditions for Pacific lamprey spawners within the Klamath River. However, coho salmon juveniles produced by IGH under the No Action alternative could prey on larval lamprey, which hatch within several weeks of spawning activity and drift downstream to backwater areas where they burrow into the substrate and commence feeding as ammocoetes (Kostow 2002). Pfeiffer and Pletcher (1964) observed that coho salmon fry prey on emergent larval lamprey. However, due to the small number of hatchery smolts released (75,000) predation by coho salmon under the No Action alternative is not likely to significantly affect juvenile Pacific lamprey due to the diversity of other prey items utilized by coho salmon juveniles and the relatively high fecundity of larvae produced by Pacific lamprey spawners.

In addition, coho salmon are prey for adult Pacific lamprey. The coho salmon adults produced by the hatchery program provide a food source for Pacific lamprey in both the marine and freshwater periods of their life-cycle. Therefore, the No Action alternative will not negatively affect Pacific lamprey adults.

4.1.2.4. Fish-Eating Birds

Under Alternative 1, IGH production likely would continue to benefit overall foraging opportunities for fish-eating birds by increasing the numbers of salmon and steelhead. However, this benefit could be offset to the extent that IGH production adversely affects natural populations of salmon and steelhead through behavioral differences that result in diminished fitness and survival of naturally-produced fish.

4.1.3. Effects on Cultural Resources, Socioeconomics, and Environmental Justice

4.1.3.1. Cultural Resources and Socioeconomic Environment

Under Alternative 1 (No Action), no effects on cultural resources are expected. As discussed above in section 3.3.1, no prehistoric or archaeological resources are known to occur within the IGH area, and no activities would occur under Alternative 1 (No Action) that could cause disturbance to other known sites in the vicinity.

Under Alternative 1 (No Action), no significant effects on population or employment are expected. As discussed above in section 3.3.1, IGH employs seven permanent positions, so the impact of Alternative 1 on regional employment and income is small.

Under Alternative 1 (No Action), PacifiCorp would continue funding 100 percent of hatchery operations and maintenance costs pursuant to the KHSA. These costs will be borne by PacifiCorp customers in the six western states, but would constitute only a minute fraction of overall costs to customers.

Effects on the tribes under Alternative 1 may include reduced cultural benefits to tribal communities in the region as a result of continued, reduced coho salmon abundance. Effects on tribal fishing are discussed further below in section 4.1.3.5.

4.1.3.2. Recreation

Under Alternative 1 (No Action), no significant effects on most recreational resources are expected including boating (standard and whitewater), camping, and day use. No activities would occur under Alternative 1 (No Action) that could cause disturbance to recreational facilities that occur within the IGH area, and elsewhere in the vicinity.

Under Alternative 1 (No Action), beneficial effects on recreational sport fishing (private and commercial) would continue as they currently occur from operation of the salmon and steelhead production program at IGH. Production from Iron Gate Hatchery contributes to recreational fisheries (as well as tribal fisheries) in the Klamath River Basin and the Pacific Ocean. In the mixed-stock coastal fisheries of the Pacific Ocean, the presence of hatchery fish allows for higher harvest levels than if there were no hatchery stocks in the fishery. Under Alternative 1, IGH would continue to produce fish that would provide support to these fisheries. However, because wild fish are harvested along with hatchery fish in coastal recreational fisheries, an increase in allowable harvest may also affect the escapement of wild stocks when these fish are harvested along with hatchery fish.

Under Alternative 1, IGH production would also continue to benefit recreational fisheries by increasing the numbers of salmon and steelhead. However, IGH production may also have an adverse effect on natural populations of salmon and steelhead through behavioral differences that result in diminished fitness and survival of HOR relative to NOR fish, and increased competition with and predation on NOR populations.

4.1.3.3. Commercial and Tribal Fishing

Production from IGH contributes to commercial and tribal fisheries in the Klamath River Basin and the Pacific Ocean. Under Alternative 1 (No Action), commercial and tribal fishing would continue to benefit from operation of the salmon production program at IGH because hatchery-produced salmon supplement these fisheries. Under Alternative 1, it is assumed IGH would continue to produce fish at historical production levels that would provide support to these fisheries. However, it is uncertain whether the coho salmon program at Iron Gate Hatchery would continue in its current form under Alternative 1.

4.1.3.4 Land Ownership and Land Use

Under Alternative 1 (No Action), no significant effects on land ownership and land use are expected. No activities would occur under Alternative 1 (No Action) that could cause changes in the current patterns of land ownership and land use in the IGH area.

4.2. Effects from Alternative 2 (Proposed Action)

Under Alternative 2, NMFS would issue an ESA section 10(a)(1)(A) permit for a term of 10 years authorizing the take of listed coho salmon at IGH pursuant to the conservation actions identified in the HGMP.

The primary goal of an HGMP is to devise biologically-based hatchery management strategies that contribute to the conservation and recovery of coho salmon. NMFS uses the information in an HGMP to evaluate hatchery impacts on salmon and steelhead listed under the ESA. The elements of implementation of the HGMP that will have greatest environmental impact are as follows: (1) Capture of approximately 27-68 unmarked adult coho to use as broodstock (the goal is for 20 to 50 percent of broodstock to be of natural origin (NOR); and (2) Volitional release of 75,000 yearling coho into the Upper Klamath River between March 1 and April 15th.

4.2.1. Effects on Water Resources

4.2.1.1. Hydrology

No significant effects on hydrologic conditions and resources are expected under Alternative 2 (Proposed Action). The potential hydrology effects under Alternative 2 (Proposed Action) would be the same as described for Alternative 1 (No Action) in Section 4.1.1.1 because there is no appreciable difference in terms of water use between the two alternatives. The current level of water use at IGH would continue. No appreciable consumption of water will occur under Alternative 2 since water diverted to IGH from Iron Gate Reservoir would be returned to the river. Also, the amount diverted would be small relative to the total river flow (less than 1 percent), and cause no effects on other water uses in the short reach (about 0.5 miles) of the Klamath River between the IGH water intake in the deeper waters of Iron Gate Reservoir and the return discharge to the river from IGH. Improvements to hatchery-related facilities (e.g., Bogus Creek weir) are not expected to have any perceptible effect on water availability or use.

4.2.1.2. Water Quality

No significant effects on water quality are expected under Alternative 2 (Proposed Action). The potential water quality effects under Alternative 2 (Proposed Action) would be the same as described for Alternative 1 (No Action) in Section 4.1.1.2 because there is no appreciable difference between the two alternatives in terms of activities that can affect water quality. Water discharged from IGH into the Klamath River would continue to contribute minor amounts of nutrient and organic matter loading to the river due to IGH operations, but these small loads are not expected to result in significant impacts to nutrients and algae in the Klamath River.

Under Alternative 2 (Proposed Action), the characteristics of the IGH discharge with regard to other water quality constituents also would likely be unchanged from current conditions. CDFW would continue to operate the IGH pursuant to an NPDES permit that establishes conditions for the IGH discharge to maintain compliance with the Clean Water Act. Therefore, Alternative 2 is not expected to result in significant impacts to other water quality constituents in the Klamath River for the same reasons as described for Alternative 1 (No Action) in section 4.1.1.2.

4.2.2. Effects on Biological Resources

4.2.2.1. Anadromous Salmonid Species

Under Alternative 2 (Proposed Action), effects on coho salmon would occur from continued operation of the coho salmon program at IGH and implementation of the HGMP. Hatchery propagation of coho salmon under Alternative 2 will require the lethal take of adult coho salmon for broodstock and the loss of individuals during incubation, rearing, and marking. Activities authorized under Alternative 2 would include collection of a minimum of 135 and maximum of 270 adult spawners (up to 50 percent of which may be NOR adults) in order to meet the IGH's goal of producing 75,000 yearling coho each year. In contrast, past hatchery operations have required the lethal take of approximately 270 fish each year to meet production objectives. Adults may enter the facility and not be used for broodstock. The disposition of excess adults will be coordinated with NMFS on an annual basis. The handling and release of these adult coho back to the river may result in injury or mortality. It is expected that less than 1 percent of the fish collected and released will suffer injury sufficient to result in mortality (Keith Pomeroy, Hatchery Manager II, pers. comm. 2012). The actions proposed in the HGMP (and that would be implemented under Alternative 2) would be expected to reduce or eliminate factors such as low fertilization rates, juvenile culling for genetic reasons, and bird predation in raceways, so that fewer adults are needed for broodstock over time. Thus, take of coho salmon from IGH activities will be reduced under Alternative 2 compared to Alternative 1 (No Action). The overall reduction in take, along with the improved genetic makeup of the broodstock, and improved rearing survival are expected to result in an overall beneficial effect on anadromous salmonid species and are not expected to result in = significant adverse effects to anadromous salmonid species.

Inbreeding – Certain components of the current management scheme (small program size, the avoidance of jacks (grilse) in the broodstock, and the lack of a genetic broodstock management program at the hatchery) are anticipated to produce progeny with decreased survival rates due to lower fitness caused by inbreeding and divergence between brood years. Alternative 2 would be expected to decrease the degree of inbreeding and divergence in the hatchery population based on HGMP activities, such as the incorporation of jacks into the broodstock, the incorporation of NOR adults into the broodstock (20 to 50 percent of total broodstock), the avoidance of HOR and sibling crosses in mating, and the adoption of a 2:1 male to female mating protocol.

Similar to Alternative 1 (No Action), under Alternative 2, the potential for indirect impacts to naturally-spawned juvenile salmon would likely result from competitive and predatory interactions, disease transfer, and interbreeding between HOR and NOR individuals in the Klamath River. Interactions would occur between HOR coho salmon and NOR coho salmon, Chinook, and steelhead. These interactions are an indirect impact of the coho salmon program at IGH and result in both positive and negative effects on salmon populations.

Predation – Based on the time and size at release, hatchery coho salmon yearlings may prey on naturally-produced coho, steelhead, and Chinook fry. With regard to coho, there is no specific data on the impact HOR coho predation may be having on NOR coho populations in the Klamath. Modeling results presented in the HGMP indicate that hatchery coho induced mortality to natural coho from predation, competition and disease is approximately 6 percent. Alternative 2 does not change the number of yearlings produced annually – it incorporates measures to improve survival from one life stage to the next so that the IGH can, pursuant to an adaptive management program, reduce the number of NOR and HOR broodstock collected as egg fertilization and juvenile survival rates improve. If successful, there may be a corresponding increase in the number of NOR coho in the river. Under Alternative 2, the impacts of this predation on NOR coho are expected to be relatively minor given the small number of fry in the main stem at the time when yearling HOR coho would be migrating and the relatively low number of HOR coho released from IGH. The impacts on Chinook and steelhead are expected to be similarly minor due to the large population sizes of both species in the Klamath[10]. In sum, NMFS does not anticipate any significant effect on predatory interactions under Alternative 2 due to implementation of the HGMP.

Competition – Similar to the impacts of predation, there is potential under Alternative 2 for impacts related to competition between HOR coho salmon and NOR coho, Chinook and steelhead for space in refugia and rearing habitat in the main stem Klamath River and tributaries. The potential for adverse effects on natural coho salmon populations is highest in late spring when lower flows and higher water temperatures may increase competition for suitable rearing habitat (Joint Hatchery Review Committee 2001). Because the release of HOR yearling from the hatchery coincides with the migration of NOR coho, Chinook, and steelhead, there is the potential for competition in areas where there is limited rearing or migratory habitat (such as the Lower Klamath). Actions under Alternative 2 would not change from existing conditions the number of coho yearlings produced per year. Competition between IGH juveniles and NOR juveniles is also expected to be low given the short residence time (22 days) of HOR yearling in the river and the low number (75,000) of IGH coho yearlings released. Under Alternative 2, there is not expected to be competition between adult HOR coho salmon and NOR adult salmon for spawning habitat because the abundances of spawners on the spawning grounds in the Klamath River are expected to remain low.

Disease –Currently, CDFW certifies the health and disease status of coho salmon prior to release and disease has not been an issue for coho salmon at IGH. Under Alternative 1, as under the current hatchery program, there are not expected to be disease effects on NOR salmon from the direct release of juvenile coho. However, because hatchery coho are susceptible to infection by the myxosporean *Ceratomyxa shasta*, returning adult coho that spawn naturally may increase the prevalence of this organism and increase disease load in the basin. This would not change under Alternative 2, so there are not expected to be significant disease effects on NOR salmon associated with implementation of the HGMP.

Interbreeding –Under Alternative 2, spawning by IGH hatchery coho salmon would be reduced in Bogus Creek and likely other tributaries with the implementation of this alternative. The HGMP calls for achieving the HSRG and CHSRG recommended PNI value of at least 0.5 in Bogus Creek and reducing hatchery strays to other streams over time. The achievement of these objectives is expected to increase population fitness, abundance and productivity.

Although there are risks from hatchery fish interbreeding with natural origin coho there can also be benefits. If natural populations are too small without the input of hatchery spawners they can experience depensation, or the negative genetic impacts of small population size (e.g., inability to find mates, inbreeding). As discussed above regarding Alternative 1, it is expected that Alternative 2 could

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[10] Modeling in the HGMP indicated for example that hatchery coho induced mortality on natural Chinook populations was less than 0.001.

benefit the Upper Klamath and Shasta populations through the contribution of strays. These two populations currently fall below the depensation thresholds set by Williams e*t al.* (2008). At these abundances they are experiencing depensation. The coho program at IGH contributes approximately 10-50 percent to these populations depending on the year and under Alternative 2 this level of straying would likely continue. The benefits from spawning contributions are at least partially offset by the negative characteristics of hatchery spawners discussed above but the influx of spawners to these populations is a net benefit to these populations given their low natural abundance.

4.2.2.2. Anadromous Salmonid Habitat

The potential effects on fish habitat under Alternative 2 (Proposed Action) would be the same as described for Alternative 1 (No Action) in Section 4.1.2.2 because there is no appreciable difference between the two alternatives in terms of activities that can affect fish habitat. Under Alternative 2, no significant adverse effects are expected on anadromous salmonid habitat. Although there is expected to be competition under Alternative 2 between HOR coho salmon and NOR coho, Chinook and steelhead in refugia and rearing habitat in the mainstem Klamath River and tributaries, this competion snot expected to result in significant adverse effects to anadromous salmonid habitat for the same reasons as discussed in Section 4.2.2.1 under Competition. In addition, Alternative 2 does not contain any habitat restoration components, and Alternative 2 does not involve any in-river or on the ground disturbance activities that will effect habitat in the area.

4.2.2.2.1. Juvenile Summer and Winter Rearing Areas

Under Alternative 2 (Proposed Action), effects on juvenile summer and winter rearing area could occur from the presence of hatchery fish. The amount of food in some areas could be limited at certain times of the year by hatchery fish. Space for rearing juveniles and fry could be limited by hatchery fish, particularly during low-flow periods in late summer.

4.2.2.2.2. Juvenile Migration Corridor

Under Alternative 2 (Proposed Action), effects on juvenile migration corridor habitats could occur from the presence of hatchery fish. Food, space, and cover could be limited in certain months and in certain areas (such as thermal refugia) due to the presence of hatchery juveniles. The presence of hatchery juveniles produced under Alternative 2 could limit the function of important habitat in the juvenile migration corridor from March to May due to reductions in food and space resulting from encroachment by these juveniles.

4.2.2.2.3. Adult Migration Corridor

There are expected to be little, if any, impacts to the adult migration corridor as a result of Alternative 2 (Proposed Action). At the time when adult hatchery coho return to the hatchery and spawning grounds, there is adequate migratory habitat to support salmon. Therefore, little, if any, competition would be expected between HOR coho and NOR salmon for migratory habitat.

4.2.2.2.4. Spawning Areas

There are expected to be little, if any, impacts to spawning habitat as a result of Alternative 2. There is expected to be adequate habitat to support HOR and NOR salmon on the spawning grounds. None of the spawning areas where IGH coho stray are at, or near, carrying capacity. Therefore, there would be little, if any, impact of HOR coho on natural spawning grounds.

4.2.2.3. Other Fish Species

The potential effects on eulachon, green sturgeon, and Pacific lamprey under Alternative 2 (Proposed Action) would be the same as described for Alternative 1 (No Action) in Section 4.1.2.2 because there is no appreciable difference between the two alternatives in terms of activities that can affect eulachon, green sturgeon, and Pacific lamprey.

4.2.2.4. Fish-Eating Birds

Under Alternative 2 (Proposed Action), IGH production likely would continue to benefit overall foraging opportunities for fish-eating birds by increasing the numbers of salmon and steelhead. However, this benefit could be offset to the extent that IGH production adversely affects natural populations of salmon and steelhead through behavioral differences that result in diminished fitness and survival of naturally-produced fish.

4.2.3. Effects on Cultural Resources, Socioeconomics, and Environmental Justice

4.2.3.1. Cultural Resources

Under Alternative 2 (Proposed Action), no significant effects on cultural resources are expected. As discussed above in section 3.3.1, no prehistoric or archaeological resources are known to occur within the IGH area, and no activities would occur under Alternative 2 (Proposed Action) that could cause disturbance to other known sites in the vicinity.

4.2.3.2. Socioeconomic Environment

Under Alternative 2 (Proposed Action), no significant effects on regional population and employment are expected. As discussed above in section 3.3.1, IGH employs seven permanent positions. Alternative 2 has the potential to result in the employment of more people in order to carry out activities required by the HGMP (such as spawning surveys, smolt trapping, broodstock genetic analysis, etc.) as compared to Alternative 1. However, the impact of Alternative 2 (Proposed Action) on regional employment is expected to remain relatively small.

Under Alternative 2 (Proposed Action), the IGH's contribution to the social and economic value of tribal, recreational, and commercial salmon fisheries in the Klamath River Basin could be enhanced by HGMP actions. Economic benefits to the region from these fisheries include: revenue generated through fish sales; jobs provided through commercial fishing and fish processing occupations; purchase of boats, boat repair services, equipment and fuel from local businesses; and the purchase of food and lodging at local motels and restaurants. However, the current ESA-listing status of coho salmon limits the ability of the region to fully benefit from salmon fisheries by limiting the opportunity to harvest surplus unlisted salmon intermingled with listed coho salmon in traditional harvest areas. Improvements in the prospects for recovery of the listed coho salmon through HGMP hatchery and monitoring and evaluation activities, and complementary habitat and harvest management actions, are expected to provide benefits to the regional salmon fisheries. Effects on recreational, commercial, and tribal fisheries are discussed further below in sections 4.2.3.3 and 4.2.3.4.

Under Alternative 2 (Proposed Action), PacifiCorp would continue funding 100 percent of hatchery operations and maintenance costs pursuant to the KHSA. These costs will be borne by PacifiCorp customers in the six western states in which PacifiCorp operates, but would constitute only a minute fraction of overall costs to customers.

4.2.3.3. Recreation

Under Alternative 2 (Proposed Action), no significant effects on most recreational resources are expected, including boating (standard and whitewater), camping, and day use. No activities would occur under Alternative 2 (Proposed Action) that could cause disturbance to recreational facilities that occur within the IGH area, and elsewhere in the vicinity.

Under Alternative 2 (Proposed Action), implementation of the HGMP is expected to improve prospects for the resumption of recreational coho sport fishing (private and commercial) in the Klamath River basin and coastal fisheries. Under Alternative 2 (Proposed Action), the total annual number of returning NOR and HOR adult coho salmon produced in the upper Klamath River would be expected to increase as a result of: (1) increased fitness and survival of hatchery fish; (2) reduction in the number of hatchery fish spawning naturally (reduced genetic effects on natural populations); (3) release of high quality smolts that migrate rapidly out of the system; and (4) the release of hatchery coho at a size similar to wild fish that migrate quickly out of the river system (reduces competition, predation and disease effects).

Monitoring and evaluation of information gathered through programs proposed in the HGMP are expected to improve the likelihood for effective application of management measures addressing human-caused factors for decline of the listed coho salmon population. Application of these measures should help protect and increase coho abundance and productivity in the Klamath Basin. Increases in coho salmon abundance and productivity are more likely outcomes under Alternative 2 (Proposed Action), potentially leading to timely recovery of the population, and subsequent resumption of conservation-based fisheries when viable, self-sustaining coho salmon returns are re-established.

Under Alternative 2 (Proposed Action), human disturbance to returning coho salmon spawners may be increased slightly during the fall and winter periods. Boat surveys, foot surveys, and other actions directed at coho salmon would be increased as a result of HGMP research, monitoring, and evaluation activities, but would be confined to discrete times during the year, and to tributary areas, when and where the fish are present. Human presence in areas to conduct survey activities would be of low intensity and not constant, limited to a few individuals and a few days per week during the season. Potential noise and visual disturbance to coho salmon spawners resulting from these activities are therefore not expected to be significant.

4.2.3.4. Commercial and Tribal Fishing

Implementation of the HGMP under Alternative 2 (Proposed Action) is expected to improve prospects for the future resumption of fisheries relative to the No Action alternative. Under Alternative 2 (Proposed Action), the total annual number of returning NOR and HOR adult coho salmon produced in the upper Klamath River would be expected to increase as a result of increased fitness and survival of hatchery fish, reduction in the number of hatchery fish spawning naturally (reduced genetic effects on natural populations), release of high quality smolts that migrate rapidly out of the system and the release of hatchery coho at a size similar to wild fish that migrate quickly out of the river system (reduces competition, predation and disease effects). Monitoring and evaluation of information gathered through programs proposed in the HGMP is expected to improve the likelihood for effective application of management measures addressing human-caused factors for decline of the listed coho salmon population. Application of these measures should help protect and increase coho abundance and productivity in the Basin. Increases in coho salmon abundance and productivity are more likely outcomes under Alternative 2 (Proposed Action), potentially leading to timely recovery of the population, and subsequent resumption of conservation-based fisheries when viable, self-sustaining coho salmon returns are re-established.

Implementation of Alternative 2 (Proposed Action) is expected to improve the prospect for future resumption of commercial and tribal fisheries by conserving the listed species, and contributing to species recovery. However, the effects of Alternative 2 (Proposed Action) on fishing are not significant because such fisheries are unlikely to resume for some time, until coho salmon populations sufficiently recover to support directed commercial and tribal fisheries.

4.2.3.5. Land Ownership and Land Use

Under Alternative 2 (Proposed Action), no significant effects on land ownership and land use are expected. No activities would occur under Alternative 2 (Proposed Action) that would result in changes in the current patterns of land ownership and land use in the IGH area.

5.CUMULATIVE IMPACTS

This chapter describes what NMFS believes are cumulative impacts occurring in the Klamath River basin. Cumulative impacts are the total effects on resources that could result when the incremental effects of Alternative 1 (No Action) or Alternative 2 (Proposed Action), as previously described above in section 4.0, are added to or interact with effects from other past, present, and foreseeable future activities or actions of federal, non-federal, public, and private entities and persons. Cumulative impacts may also include the effects of natural processes and events.

5.1. Water Resources

As described above in sections 4.1.1 and 4.2.1, neither Alternative 1 (No Action) nor Alternative 2 (Proposed Action) are expected to have significant effects on hydrology and water use in the Klamath River. As such, neither Alternative 1 (No Action) nor Alternative 2 (Proposed Action) would contribute to any significant adverse cumulative impacts to hydrology and water use in the Klamath River. The Klamath River's hydrology would continue to be dominated by the Klamath Basin's natural hydrologic character and upstream management of flow volumes from Upper Klamath Lake and releases from Iron Gate dam.

Alterations to the Basin's natural hydrologic character began in the late 1800s, accelerating in the early 1900s, including construction and operation of Reclamation's Klamath Irrigation Project. The Klamath Irrigation Project includes facilities to divert, store, and distribute water for irrigation, National Wildlife Refuges, and to control of floods in the basin. At present, Reclamation is responsible for management of flow volumes in the upper Klamath River, including flows that both enter (from Upper Klamath Lake at Link River dam at RM 254) and exit (from Iron Gate dam at RM 190.5) the area occupied by PacifiCorp's Project developments. Reclamation's management of flows in the upper Klamath River is based on operational plans developed in consultations with USFWS and NMFS to protect the federally listed Lost River and shortnose suckers, and SONCC coho salmon, and their designated critical habitats. In March 2010, NMFS issued its final biological opinion (BiOp) on Reclamation's operation of its Klamath Project for the period 2010-2018 (NMFS 2010). That BiOp, as well as NMFS' 2012 BiOp on proposed issuance of an incidental take permit to PacifiCorp under ESA section 10(a)(1)(B) and implementation of a Habitat Conservation Plan for interim operations of PacifiCorp's Klamath Hydroelectric Project (NMFS 2012b), contemplate PacifiCorp's interrelated operations of Link River dam and Iron Gate dam consistent with the 2010 Reclamation BiOp, and cover PacifiCorp's coordination with Reclamation over implementation of certain Reclamation operations. The BiOp on Reclamation's operation of its Klamath Project also identifies modified minimum flow releases from Iron Gate dam.

As described above in sections 4.1.2 and 4.2.2, neither Alternative 1 (No Action) nor Alternative 2 (Proposed Action) are expected to have significant effects on water quality in the Klamath River. As such, neither Alternative 1 (No Action) nor Alternative 2 (Proposed Action) would contribute to any significant adverse cumulative impacts to water quality in the Klamath River. The Klamath River's water quality would continue to be dominated by a wide range of natural and anthropogenic influences affecting water quality in the Klamath Basin.

Inflows to the Klamath River (at Link River dam) originate from Upper Klamath Lake. Diversions and return flows for agriculture, as well as municipal and industrial use, occur in the reach between Link River dam and Keno dam (ODEQ 2010). Upper Klamath Lake is nutrient-enriched (hypereutrophic), and experiences large, recurring algae blooms (ODEQ 2010). As a result the quality of the water flowing from Upper Klamath Lake is the "driver" that dictates water quality throughout the Klamath River (NCRWQCB

2010, ODEQ 2010). The influence of Upper Klamath Lake's highly variable and seasonal discharges of large quantities of algae, nutrients, and organic matter on downstream river reaches can be dramatic, especially related to algal production and associated effects on DO, pH, and alkalinity (NCRWQCB 2010, ODEQ 2010, FERC 2007, NRC 2004). The impact of upstream reaches diminishes with distance downstream of Iron Gate dam, but even with 190 miles of free flowing river and multiple tributaries, the large loads of nutrients and organic matter out of Upper Klamath Lake and the upper basin play a role in the water quality of the Klamath River downstream to the Pacific Ocean.

The Klamath River TMDL in California (NCRWQCB 2010) includes water temperature, dissolved oxygen, and nutrient-related numeric targets and waste load allocations for the hatchery as well as other Klamath River sources. With implementation of measures as required by NCRWQCB (2010) to achieve these water quality targets it is expected that hatchery operations will not contribute to any significant adverse cumulative impacts to water quality in the Klamath River.

5.2. Biological Resources

5.2.1. Fish Species

Alternative 1 (No Action) could cause an increased risk of extinction for the SONCC coho salmon ESU when added to other past, present, and reasonably forecast future actions. The intent of the HMGP is to implement and devise biologically-based hatchery management strategies that contribute to the conservation and recovery of the species. As described above in section 4.2.2, full implementation of the HGMP under Alternative 2 (Proposed Action) would increase egg-to-yearling survival and decrease the genetic and demographic risks of inbreeding (at the hatchery) and hatchery and natural interbreeding (on the spawning grounds) further aiding recovery of the SONCC coho salmon ESU. Accordingly, although there are still risks from predation, competitive interactions, and interbreeding the conservation benefits of Alternative 2 outweigh the risks associated with Alternative 2. Implementation of the HGMP under Alternative 2 (Proposed Action) would support recovery of the Upper Klamath and Shasta population units that might otherwise continue to decline irreversibly. The overall reduction in take, improved genetic makeup of the broodstock, and improved rearing survival are expected to result in an overall beneficial effect on anadromous salmonid species and are not expected to result in significant adverse effects to anadromous salmonid species. Based on these factors, Alternative 2 is not expected to contribute to any significant adverse cumulative impacts on fish species.

The settlement and development of the Klamath River Basin has caused substantial adverse cumulative effects on the habitat and population size of coho salmon. Although also adversely affected from development in the basin, Chinook and steelhead have not suffered as significant declines as coho. In addition to the gold mining, timber harvest and grazing impacts previously discussed, starting around 1905, construction and operation of facilities associated with Reclamation's Klamath Irrigation Project resulted in extensive draining of wetlands, increased agricultural diversions, increased nutrient loading, and reduced dissolved oxygen levels. In the 1920s, the water resources in the Shasta and Scott Rivers were developed to support irrigated agriculture, and the construction of Dwinnell dam blocked access for salmonids to the southern headwaters. Agricultural diversions in these tributaries and in the tributaries to Upper Klamath Lake have reduced flows, increased water temperatures, and increased nutrient inputs. Construction of Copco No. 1 dam in 1918 blocked Chinook salmon from accessing about 350 miles of habitat upstream of Upper Klamath Lake and about 55 miles of mainstem habitat between Copco No. 1 dam and Upper Klamath Lake. Construction of Iron Gate dam in 1962 blocked access to additional mainstem habitat and tributaries including Fall and Jenny creeks. Diversion of up to 80 percent of the flow from the Trinity River basin to support agriculture in the Sacramento River Basin started in 1964 with the completion of Trinity and Lewiston dams.

Overfishing also contributed to the decline of coho salmon in the basin, although NMFS (2002) believes that fishing mortality has been reduced substantially since the retention of naturally produced coho salmon south of Cape Falcon, Oregon, was prohibited in 1994. Competition with Chinook and coho salmon produced at Iron Gate and the Trinity River hatcheries has also adversely affected wild runs of coho salmon and possibly Chinook. NMFS (2002) reports that approximately 95 percent of the coho salmon run in the Trinity River above Willow Creek and about 65 percent of the coho salmon run in the Klamath River above Weitchpec consist of hatchery fish. Prior to the construction of Iron Gate dam in 1962, peaking operations at the Copco developments adversely affected anadromous fish by causing large daily fluctuations in flow, which likely resulted in extensive fish stranding. The Klamath Hydroelectric Project contributes to adverse cumulative effects on coho salmon by blocking access to tributary habitats upstream of Iron Gate dam and contributing to poor water quality below Iron Gate dam.

Periodic changes in Pacific currents, winds, and upwelling regimes have substantial effects on the primary and secondary productivity of the northeast Pacific Ocean (Brown et *al*. 1994,Mantua et *al*. 1997). These oceanic events, described as El Niño/Southern Oscillation (ENSO) and Pacific decadal oscillation (PDO) are associated with declines and increases in ocean survival and decreases and increases in size of coho and Chinook salmon (Johnson 1988, Spence et *al*. 1996, Tschaplinski 1999, Cole 2000, Ryding and Skalski 1999, and Koslow et *al*. 2002). Steelhead appear to be more resilient to fluctuating ocean conditions. Substantial changes in salmonid ocean survival associated with these cyclical oceanic oscillations can make it difficult to isolate and determine the effects of both long- and short-term changes in the condition of freshwater spawning and rearing habitats, and of conditions in the migration corridor downstream of Iron Gate dam. Despite the role ocean conditions play in returns of adult salmonids to the Klamath River, NMFS considers poor freshwater survival a significant threat to the long-term conservation of naturally produced salmonids in the basin.

5.2.2. Fish-Eating Birds

As described above in sections 4.1.2.3 and 4.2.2.3, Alternative 1 (No Action) would maintain the current contribution that IGH production has on forage for fish-eating birds, and Alternative 2 (Proposed Action) would likely increase the contribution that IGH production currently has on forage for fish-eating birds. The contribution of IGH production to forage for fish-eating birds, when added to other past, present, and foreseeable future actions, will result in beneficial cumulative effects on these birds.

Bald eagle and osprey have made a strong comeback from the mid 1960s and ‘70s when they were severely impacted by the use of DDT, a widely used pesticide now banned in the United States. DDT caused significant declines in fish-eating birds as the chemical was accumulated by prey and resulted in reproductive failures of the birds. Populations of these species are considered stable and expanding and the bald eagle was removed from the list of endangered and threatened species in the U.S. in 2007. In the Klamath River basin it is believed bald eagles are expanding their numbers and breeding and foraging ranges. Similar trends are observed with the osprey.

5.3. Cultural Resources, Socioeconomics and Environmental Justice

As described above in sections 4.1.3 and 4.2.3, neither Alternative 1 (No Action) nor Alternative 2 (Proposed Action) are likely to impact identified historic or cultural resources. As such, neither

Alternative 1 (No Action) nor Alternative 2 (Proposed Action) would contribute to any significant cumulative impacts to these resources.

Human population growth in the area is expected to continue. Most of this growth is expected to occur in the valley bottom settings near Yreka and in the Scott and Shasta Valleys. Employment has grown consistently in the area in the past 25 years, but at a pace slower than the Oregon and California averages. Employment growth has been accompanied by a shift in jobs away from the manufacturing sector and into other sectors, including services, retail trade, and government, as well as agriculture in some areas.

Production from IGH contributes to commercial, tribal, and recreational fisheries in the Klamath River Basin and the Pacific Ocean. Under Alternative 1 (No Action), commercial, tribal, and recreational fishing would continue to benefit from operation of the salmon production program at IGH because hatchery-produced salmon supplement these fisheries. However, it is uncertain whether the coho salmon program could continue in its current form under Alternative 1. Under Alternative 2 (Proposed Action), further increases in coho salmon abundance and productivity are more likely to occur, contributing to the conservation and recovery of the species, and subsequent resumption of directed fisheries.

Historically, communities along the coast were dependent on commercial and recreational sportfishing. Along with commercial fishing, the coastal communities also depend on the packing and processing plants that prepared the fish for market. However, most of the packing and processing plants, whose employment used to be reported as part of the manufacturing sector, have closed. Declines in salmonid abundance since the 1980s has adversely impacted coastal fishing communities as previously described in this EA. Continued wide fluctuations in Klamath and Sacramento River Chinook stocks are likely to lead to further impacts on local fishing communities and local economies the commercial and recreational fisheries support. Such wide fluctuations make it difficult for fishers to plan for annual income and leads to abandonment of salmon fishing as a reliable source of income.

The tribal communities in the area experience higher rates of food insecurity, poverty, and unemployment than non-Indian communities. Additionally, they suffer from substantially higher rates of some diseases, including diabetes and heart disease. These problems are linked to the loss of the tribes' traditional ability to rely on the Klamath River and its resources for their subsistence, culture, spiritual traditions and practices, and economic security. The deterioration of water quality and habitat as a result of a variety of anthropogenic actions in the Klamath Basin have contributed to that loss.

5.4. Land Ownership and Land Use

Under either Alternative 1 (No Action) or Alternative 2 (Proposed Action), no significant effects on land ownership and land use are expected. No activities would occur under either alternative that would result in changes in the current patterns of land ownership and land use in the IGH area.

NMFS anticipates land use will not change during the permit term; however expansion of commercial and residential developments is likely to occur particularly in cities such as Yreka, California, and Klamath Falls, Oregon. Obviously, European settlement of the basin since the mid-1800's has significantly altered the natural landscape and developed native habitats into land uses such as irrigated agriculture, mining areas, timber production zones, and residential and commercial development. This human development has altered the natural environment including the Klamath River watershed.

Once development and associated infrastructure (roads, drainage, water development, etc.) are established, the impacts to aquatic species are expected to be permanent. Anticipated impacts to aquatic resources include loss of riparian vegetation, changes to channel morphology and dynamics, altered hydrologic regimes (increased storm runoff), increased sediment loading, and elevated water temperatures where shade-providing canopy is removed. The presence of structures and/or roads near waters may lead to the removal of large woody debris in order to protect those structures from flood impacts. The anticipated impacts to Pacific salmonids from continued residential development are expected to be sustained and locally intense. Commonly, there are also effects of home pesticide use and roadway runoff of automobile pollutants, introductions of invasive species to nearby streams and ponds, attraction of salmonid predators due to human occupation (e.g., raccoons), increased incidences of poaching, and loss of riparian habitat due to land clearing activities. All of these factors associated with residential development can have negative impacts on salmon populations.

Agricultural activities in area include grazing, dairy farming, and the cultivation of crops. Impacts on water quality are expected to be regulated under applicable laws. The impacts of this use on aquatic species are anticipated to be locally intense, but the longevity of the impact depends on the degree of grazing pressure on riparian vegetation, both from dairy and beef cattle. Grasses, willows, and other woody species can recover quickly once grazing pressure is reduced or eliminated (Platts 1991) through fencing, seasonal rotations, and other measures. If appropriate measures are not taken to improve practices over time and reduce grazing pressure, impacts to aquatic species are expected to remain static. Grazing impacts include decreased bank stability, loss of shade and cover-providing riparian vegetation, increased sediment inputs, and elevated nutrient levels.

5.5. Climate Change

Under either Alternative 1 (No Action) or Alternative 2 (Proposed Action), no significant effects to climate change are expected. No activities would occur under either alternative that would result in changes to greenhouse gas emissions or other pollutants that are likely to significantly contribute to environmental conditions associated with climate change.

Climate change poses a high threat to salmonids within the area, particularly coho salmon. Rearing and migratory habitat are most at risk to climate change. Increasing water temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. Adults may also be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (ISAB 2007, Feely et *al*. 2008, Portner and Knust 2007). Overall, the range and degree of variability in ambient temperature and precipitation are likely to increase in all populations, creating long term threats to the persistence of coho salmon in this area.

Although long-term trends in climate change are likely to place additional stress on the conservation and recovery of the SONCC coho ESU, NMFS does not expect that climate change will be significant enough to have a noticeable effect on coho in the Klamath River basin during the 10-year permit period. The current climate in the area is generally warm, and long-term modeled regional average temperatures shows a large temperature increase; with average ambient temperatures increasing by as much as 3°C in the summer and by 1°C in the winter, while annual precipitation in this area is predicted to trend downward over the next century. Additionally, it is predicted that snowpack in upper elevations of the Klamath basin will decrease in response to changes in temperature and precipitation (California Natural Resources Agency 2009).

6.LIST OF AGENCIES/PERSONS CONSULTED

The following parties were consulted during the development of this EA: CDFW, PacifiCorp, the Klamath Tribes, the Karuk Tribe, the Yurok Tribe, and the Hoopa Valley Tribe. Written comments from the Karuk Tribe and Yurok Tribe were received during development of the HGMP, and responses to these comments were incorporated into the final HGMP. Copies of the comments are appended to the application materials.

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